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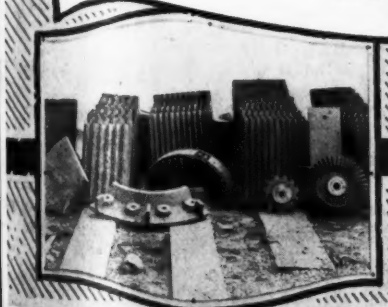

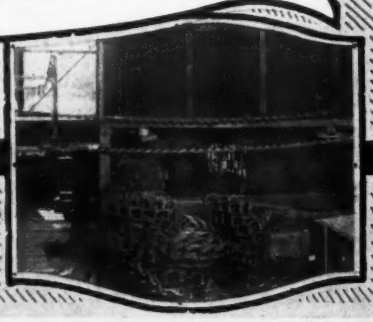

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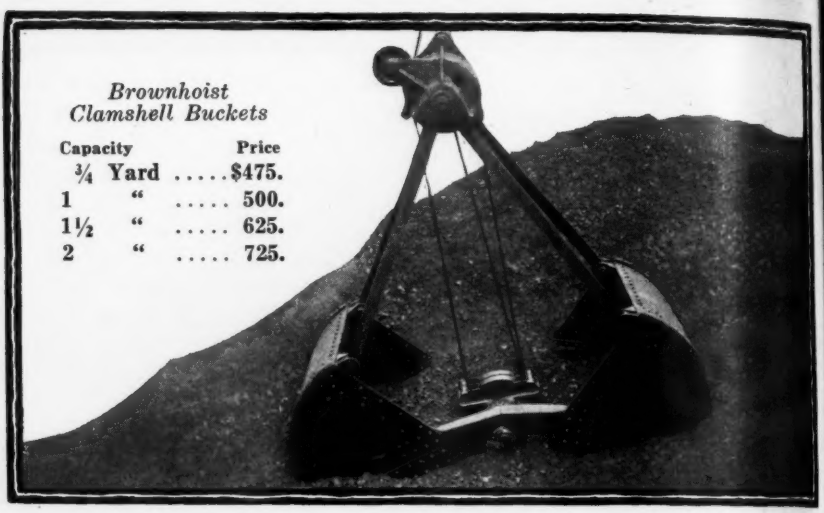

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Vol. 6 Chicago, Ill., August, 1922 No. 11

View of Plant of International Silica Company at Elco, Illinois

Illinois Silica Plant Serves Many Important Industries

A CONCERN that is actively and successfully engaged in making the most of some of the natural resources of its section of the country, and which bids fair to enjoy a still greater measure of success in the future, is the International Silica Company of Cairo, Illinois. Under the energetic direction of Mr. A. M. Davis, secretary and treasurer of the company, they are supplying steadily increasing and broadening markets with materials that meet a wide variety of needs.

The principal product is an inert silica which is 98 to 99 per cent pure. This is sold principally to paint manufacturers as a filler for many kinds of pigments. Silica used for this purpose was at one time considered an adulterant, but it has been found after considerable experiment that this material has more merit and plays a more important part in the manufacture of paint that was suspected. It fills holes in wood, and gives bulk and "tooth" to the paint.

The manufacture of mechanical rubber has recently opened up another use for this material, and silica is now replacing 10 per cent of the zinc oxide formerly used in the process. The advantages of its use over zinc oxide are readily apparent when one remembers that zinc oxide has been sold, not so long ago, around 10 and 12 cents a pound. It has, too, a greater tensile strength and contributes in an important way to this primarily important quality of good rubber. In fact, so far as experiments conducted up to this time indicate, good silica imparts strength to almost anything with which it is mixed.

During the war, when French calcined flint, considered so indispensable in a number of the porcelain manufacturing industries, was no longer obtainable and it was necessary to find an American substitute, the International Silica Company found that it was able with its product to fill the bill very nicely and that, too, with advantage to the user over the French

product. Extensive laboratory tests have shown that the silica has greater mechanical strength in vitrified porcelain, that it improves translucency and permits better coloring. It is becoming more popular for this purpose right along, just as it is steadily making better headway among the manufacturers of mechanical rubber.

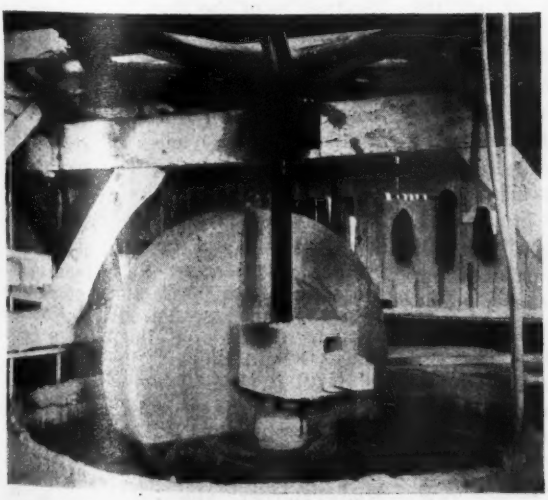
The silica in its natural state is an amorphous variety, a decomposed flint, practically pure, with a slight trace of iron and the least bit of aluminum. It is removed by underground mining methods of the "room and pillar" type. Stratification is even, and this feature makes for considerable convenience. Blasting with dynamite must be carried on regularly to provide sufficient loose material for removal. Great precautions must be taken to load only select material and the mining operation is, consequently, quite an expensive one.

The silica mines are located about two miles from the plant, which is at Elco, Illinois, a distance of some 20 miles from Cairo. The material is hauled by wagon and truck from the mines to the plant.

At the mills the silica is first put through one of the chaser mills, here illustrated, where it undergoes a preliminary pulverizing. This action takes place in water and the silica is reduced to various finenesses, so that some of the material would pass a 250, some a 350, and some a 450 mesh. The grades are determined by a water classification system. The chaser mills, made by the company, consist of large circular grinding stone, which run around a shaft, approximating in their action the work of a mortar and pestle. The stone wheels are adjustable, and may be set at just the points to do the most work and suffer the least wear.

From this point the silica and water are passed on to large concrete settling vats, as shown in the accompanying illustration. Here the water is taken off by a jet or pump process, either of which the plant is equipped to employ. The sediment is then dried by steam that is supplied by parallel series of pipes running along the bottoms of the vats.

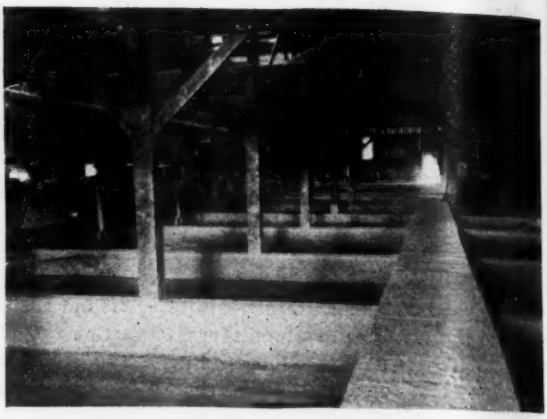
From the vats the dried silica is passed through a pulverizer made by Sprout-Waldron & Company, of Muncy, Pa. This removes cakes from the material and it is then in proper condition for packing in bags and barrels, or for loading in bulk. The product is supplied to the company's customers in any degree of fineness required. The weight of the total amount of silica leaving the plant is from 20 to 25 per cent less than that which is brought in, the difference being accounted for by moisture that is eliminated in the milling process.



One of the Chaser Mills for Preliminary Reduction

In addition to the various grades of pulverized silica, which the company furnishes for

so many different purposes, there are two other products related to the silica, but serving widely divergent purposes. One of these is a grade of ganister, and the other a bonding gravel that is known by the trade name of "Novaculite."



Moisture is Removed in Large Concrete Settling Vats

The ganister contains 96 to 98 per cent silica, the remaining part being aluminum and ferrous oxide. The prepared material is used for refractory purposes, and is employed quite extensively in the making of boiler linings and facings, bricks for gas retorts, and all purposes requiring a material that is able to stand a very high degree of heat. 8he company controls very large deposits of this ganister which occurs as a soft decomposed variety. It is a proved success for refractory purposes, and the demand for it is growing continuously. It is used extensively for macadamizing roads.

The method of mining the ganister is similar to that for taking out the silica. It is excavated by underground mining of the "room and pillar" kind. The company does not process the material, but supplies it in its crude form to concerns engaged in the making of products in which it is needed.

The Novaculite gravel is just a little lower down in the scale of silicious content. It contains about 90 per cent silica and ten per cent aluminum and ferrous oxide. It is a cherty stone mixed with red clay, quite tightly compacted in its natural bedding.

This quality of compactibility shows up to considerable advantage when the material is used for road and street pavement. It is an ideal bonding material. Roads built with it are very hard and smooth, and show no tendency to become affected by water, but run off at the sides. On account of its excellent qualities, it is being shipped a considerable distance in all directions from Cairo, as far as freight rates will permit its purchase. Many Alexander County roads are built with this Novaculite bonding gravel and in all cases where it is employed it is standing up wonderfully well. A number of streets in Cairo speak volumes for this material. These streets are hard and level, drain well, and are very easy to build, requiring only the loading in of the material and the use of a steam roller.

The International Silica Company controls about 1,000 acres of ground containing good silica, 140 acres of ganister, and 80 acres of Novaculite. The president of the concern is Mr. George Parsons.

The Binghamton Limestone Co., Binghampton, N. Y., has plans under way for the construction of a new plant at Montrose, Pa. E. E. Kellogg, treasurer, care of Kellogg-Jones Company, O'Neill Bldg., is in charge.

The Leesburgh Sand & Supply Co., St. Petersburgh, Fla., has been incorporated with a capital of $10,000. Directors: C. L. Raymond, president; Knox Burger, vice-president; R. W. Smith, secretary and treasurer.

Rules for Blasting Rock

BY DANIEL J. HAUER

THE drilling of blast holes and the blasting of rock have been much discussed subjects for years. The methods of drilling have changed rapidly during the past two decades due to the advent of mechanical drills. This has changed oldtime practices: the size of drill holes, their spacing and even the charge of explosives used differs from that of twenty years ago.

For decades there has been a desire on the part of those interested in loosening rock from the ledge, to be able to teach others how to plan and make blasts without an ocular demonstration. That is, to lay down some rule or formula, or make up tables from previous records that can be adapted to new work. If this could be done it would be a decided step forward in the industry, for not only could men be trained to better advantage but more economical blasting would be done. As it is today, each blaster follows his own self-made rules based upon his own experience and what he has seen of the methods of others, but the information that he gleans from others is mostly by word of mouth.

These and many other reasons, such as the density and hardness of different kinds of rock, the stratification and cleavage, seams and joints and faults in rock formations and the location conditions that may exist, such as the height of the ledge, the reason for loosening the rock and for what purpose it is to be used, have led most blasters and writers on this subject to state that "set rules cannot be made for spacing holes and making blasts, nor is it possible to derive formulae for the blasting of rock."

This has been the consensus of opinion in the past, yet today it has been found possible to do much towards setting a standard of practice. For instance in driving mining tunnels and adits it has been found that experimental blasts could be made for the first hundred feet in order to decide upon an exact spacing of hole as well as of the charges to be used. With these experiments it has been possible to drive holes by a template, put in the same charges for each shot, fire the holes in a regular order and obtain satisfactory and economical results, making progress that was unknown under the old method which permitted a drill runner or a blaster to decide these things for himself at each blast.

Just as this kind of work has been done in tunnels, similar methods have been followed in open cuts and quarries. This means that an intelligent blaster or superintendent has been able to make up a rule or a table to guide him in his own work. Surely such a rule could be followed in another quarter where the stone and conditions are similar. If it can be done in two quarries it can be done in others, and with a flexible rule or formula, there are no valid reasons why it can not be varied to give economical results in most quarries.

Based upon what has been done in the past, and a broad general knowledge of geology and the use and properties of explosives, the writer states emphatically that *most blasting can be done by rule or formula.* The fact is, he has derived from data he has collected, rules or formulae for such work as trenching, railroad and canal cuts, side hill blasting, the blasting of overburden and also for quarries.

It is proposed to discuss in a series of articles many features of drilling and spacing holes and blasting rock, past practices and present, leading up to the use of such rules as have been

derived by himself and others, and showing how such rules will give economical results.

The old method of blasting, before the days of dynamite, was to drill a hole with hand drills, spring it and shoot it with black powder. This explosive is put off by ignition, thus releasing gases rapidly and causing a disruptive force that blew down the rock. For this reason it is termed an "impulsive explosive," and is classed, since dynamite came into use, as a low explosive.

Dynamite, being a detonating powder, is classed as a high explosive. It is slow burning as compared with black powder; therefore it is more difficult to ignite and it must burn longer before enough heat is generated to explode it. For these reasons dynamite is exploded by detonating. Being a high explosive, its disruptive force is much greater than black powder, so that it will not only disrupt rock located above the charge but, to some extent, the rock below it to a greater degree than a low explosive.

For these reasons a popular belief has grown up among the so-called practical blasters, that black powder *shoots up* and that dynamite *shoots down*. The reason given for this by these same men is that black powder is a gaseous powder, while dynamite is not; therefore the gases go up, causing the work of black powder to be up. These ideas and theories are erroneous.

All explosives are reduced either by ignition or detonation to gases. It is the sudden formation of these gases and their expansion at a high temperature that causes the great disruptive force and rends asunder the solid rock.

The theory of an explosive is that, if a charge could be suspended in the air and detonated, the gases forming would start a series of waves that would emanate as sets of concentric circles, getting larger and larger until all their force was used up. At the same time the charge exerts an even pressure in all directions, just as though it were in the center of a sphere and the power generated went with equal force to the entire circumference.

This is the accepted theory, that both low and high explosives exert a pressure in all directions. But the great part of the work they do in loosening rock is in the line of least resistance. This is true of both black powder and dynamite. The fact, though, that the low explosive, black powder, throws rock up and out with great force and does little shattering to the wall behind and the floor beneath the charge, has caused blasters to say that it shoots up, and that dynamite throws out and up with greater force, and frequently breaks into the back wall and some rock beneath the charge on the floor. This characteristic has given rise to the idea that dynamite shoots down.

A graphic illustration of the work done by the two explosives is shown in Fig. 1.

The practice in using black powder is to spring the drill hole, thus making a chamber to take the charge. This is illustrated in Fig. 2.

The first spring is shown in the sketch, breaking the side walls and the bottom. The second spring breaks the bottom deeper and enlarges the chamber. If the charge for the third spring is confined to the chamber thus made, the break caused by a well tamped charge should be approximately as shown, while the fourth spring will go deeper and greatly enlarge the chamber along the lines as shown in the sketch. The hole may be increased in depth from 6 inches to a foot. Naturally it breaks up in the sides a little with each spring.

It has been found that a rule can be laid down for springing holes. For instance if one stick of dynamite can be used for the first spring and three sticks for the second spring without filling up the bore of the hole, then

each successive charge can be multiplied by three. Thus, in this case, the third spring is made with nine sticks and the fourth spring with twenty-seven sticks. This would allow at least 8 sticks to be used in the chamber so made. If the first two charges have

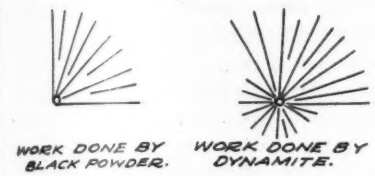


Fig. 1

the ratio of two or four, then the successive charges are gaged by these multiples. Thus the rule for gaging the springing charges is:

Rule: Divide the number of sticks of dynamite used in the first spring into the number of sticks used in the second spring, confined to the chamber, and with this multiple each successive charge is found by multiplying the last charge by the multiple so found.

If a drill hole is not sprung, the line of breakage is likely to follow up the hole for some distance and then break behind the hole near the top. This is shown in Fig. 3. In most cases part of the bore of the drill hole can be seen after the blast.

In Fig. 4 is shown the probable breakage of a well sprung drill hole. There are seldom any marks of the drill hole left.

Due to the fact that dynamite is used very extensively in quarries, many operators no longer spring their holes, believing it is cheaper not to do so. Instead, double rows of drill holes are used and fairly efficient results may be obtained, but the cost of either the drilling or the explosives is likely to be excessive. The idea of not springing holes has arisen, not only from the use of dynamite in place of black powder, but also from the extensive use of well drills for mine stripping, open cuts, and quarries.

Well drills have been succeeded by a specially designed drill of the same type for deep and big blast holes. This method of drilling and blasting has proved more economical in most cases than the older methods of hand and machine drilling. With these machines a larger bore hole is drilled, and also a much deeper hole than could be drilled by other methods. The former is called a "big blast hole," the latter a "deep blast hole." Blast holes more than 200 feet deep have been drilled. Whether such depth of holes proved economical is questionable.

With the big blast hole much larger charges of explosives could be used without running the explosives up too high in the hole, and thus shot. This saves the cost of springing, so that today very little springing is done in most quarries, whether they use the big blast hole drills or other smaller machines. A few years ago in a very large crushed stone quarry, the writer found that only hammer drills were used and in spite of this, not a hole was sprung. In the opinion of the writer, this was a great mistake, and a costly one.

Much has been written in this dis-

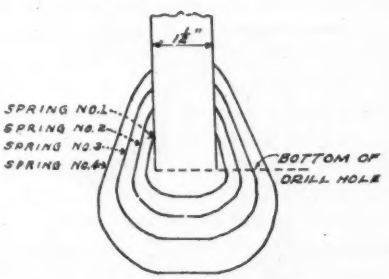


Fig. 2

cussion on the springing of holes, for in using any rules and formulae for spacing, drilling and blasting holes, it makes a great difference whether holes are sprung or not, and a different rule must be used where the practice of

springing is dispensed with, from that used where springing is done. This fact must be borne in mind.

Another factor in making large blasts is the arrangement of the drill holes in one or more rows. Holes fired in series are a decided advantage, and if several rows are fired in series, the amount of work done by a blast is frequently increased, for one charge helps the other.

In order to understand these things clearly a blaster should know what yardage or tonnage a pound of powder will loosen and break up. This will vary with the height of the ledge or the depth of the hole, upon the area of the face and whether or not more than one face is used on the ledge, and whether or not the face is breasted up before blasting. It will also vary with the density and weight of the rock and other physical and geological features. As already explained, the amount of rock loosened will depend upon how the charge is placed in the hole. To what extent the rock is broken up will likewise depend upon how the charge is placed. The kind of powder used will also cause variations in the tonnage.

The same kinds of rock will likewise vary in weight, not only in different

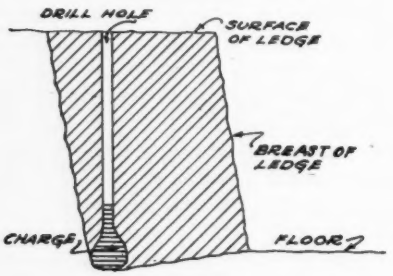


Fig. 3

sections of the country, but also, at times, in the same ledge. Thus, in limestone, the greater the amount of magnesia in the rock the less it will weigh per cubic yard. Any figures that can be given are only averages and cannot be followed literally.

It is always advisable for a quarryman to know the weight of the stone in the ledge per cubic yard, and also what weight it will run per cubic yard when converted into his products. The

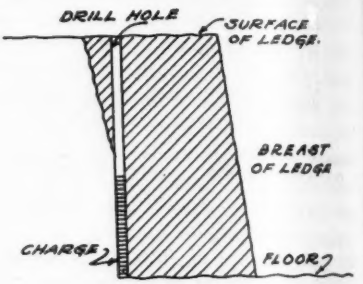


Fig. 4

following are some averages for place measurement:

	Weight per cu. yd.	Factor to convert yardage into tons.
Friable Sandstone	3,200 lbs.	1.6
Dense Sandstone	3,500 lbs.	1.75
Shales	4,000 lbs.	2
Slate and Heavy Shales	4,400 lbs.	2.2
Limestone	4,500 lbs.	2.25
Dolomite	4,600 lbs.	2.3
Granite	4,800 lbs.	2.4
Dense Trap Rock	5,000 lbs.	2.5

A statement that one pound of dynamite would loosen two cubic yards of rock can be converted as follows, so that it will express the amounts of loosened material in tons instead of cubic yards:

Friable Sandstone	3.2 tons
Dense Sandstone	3.5 "
Shales	4.0 "
Slate and Heavy Shales	4.4 "
Limestone	4.5 "
Dolomite	4.6 "
Granite	4.8 "
Dense Trap Rock	5.0 "

Thus the tonnage would vary from about three to five, nearly doubling in weight. This means that there must be some standard set of one kind of stone, convertible by factors to the other classes of rock. There must like-

wise be a standard set for the explosives to be used. For, as already pointed out, there are high and low explosives and the high explosives are made in different grades, as there are 20 per cent, 30 per cent, forty per cent and so on up of dynamite. These terms, as originally used, meant that the dynamite contained these percentages of nitroglycerine, and some brands of dynamite still do, but others have explosive chemicals as a substitute for nitroglycerine, cutting down the amount of that chemical to make them safer or non-freezing. The term percentage, as now used, denotes a dynamite of that strength, being based upon the strength of nitroglycerine as an explosive. Thus 40 per cent strength, which may be termed the standard dynamite in use, means an explosive equal in strength to a dynamite containing 40 per cent of nitroglycerine.

The writer has always adopted a dense sandstone as the standard rock and, with this as a basis, has derived his formulae and used a factor to convert the results thus obtained for other kinds of rock.

It has always been considered that black powder in fair size charges with a heavy overburden in front and above the charge, should loosen three cubic yards of a sandstone ledge per pound. Thus, to use the term "theoretical blasting," two hundred pounds of powder in one or more well sprung holes with the proper stemming or tamping should loosen six hundred cubic yards or 1,050 tons. This would be theoretical blasting, but it is seldom obtained. Instead records show that with black powder, in most cases only from one to two cubic yards are loosened; in rare cases from two to three cubic yards are thrown down.

With the harder rocks less amounts are loosened, seldom exceeding two to two and a half cubic yards. It can be seen from the table that, if a pound of black powder will loosen 5.25 tons of dense sandstone, it should not loosen quite as much tonnage in the harder dense trap rock, and the same tonnage in the trap rock would only be a little more than two cubic yards.

With 40 per cent dynamite, "theoretical blasting" means to loosen four cubic yards of dense sandstone. This is equal to seven tons of that rock. At times this is obtained, but the records which run from one to three cubic yards exceed those which run over three yards. The same tonnage in granite or trap rock would mean not quite three cubic yards. The writer has before him as he writes a record of sandstone in a railroad cut blasted with a 40 per cent dynamite where seven tons or four cubic yards were loosened—and another record in a trap rock quarry where 60 per cent strength dynamite was shot in spring holes and eight tons of rock were loosened to the pound. This meant 3.2 cubic yards of trap.

Good blasting, though, with 40 per cent dynamite in almost any stone is about two to two and a half cubic yards. To go below two cubic yards means indifferent blasting, while to obtain less than one and one-half cubic yards is exceedingly poor. In spite of this, many records of large blasts which are given publicity as indicating efficiency show less than two cubic yards to the pound of dynamite. It is true that in many cases the figures published are not accurate. Not many operators have any ready means of measuring the yardage, and, even if the stone is weighed, such weights are those of loosened stone instead of place measurement. However, some records are authentic and the writer has measured up many blasts made by himself and others and has found that poor blasting results were obtained.

The need of a high standard to which all may work is thus shown, and rules and formulae would furnish such a standard.

One reason for poor economical results obtained from blasting is the spacing of holes. The second is the placing of the charge, the third is the using of more explosives than are necessary to do the work.

In quarry work the writer has been surprised to see how much money is wasted not only in explosives, but also in drilling, when deep blast holes are used. A few years ago he was called upon to do some work in one of the largest crushed stone quarries in the east. He found extensive plans being made during the winter for some large blasts in the spring. On one level a breast of rock forty feet high was being worked and it had been drilled for blasting. The deep blast hole driller had been used and holes were placed in a circle around the breast ten feet apart.

On another level in the quarry the well drill had sunk holes to a depth of eighty-five feet and the writer was surprised to find these holes also spaced ten feet apart. This was certainly an economic blunder. If the forty-foot holes had the proper spacing with ten feet, then the eighty-five-foot holes should have been spaced at least twenty feet apart.

One authority says, "Spacing can be increased as the height of the working face increases." If quarrymen generally know of this rule for deep hole blasting many of them do not follow it. The rule covers not only the spacings between the holes themselves, but also the distances back from the face of the ledge.

The spacing of holes has as much to do with the ultimate cost of blasting as any one factor. The drilling itself is a large item, involving hundreds to thousands of dollars in a season. If explosives are to be used economically, the spacing of the holes must be proper. Thus, the first rule in blasting to be laid down must cover the important work of spacing holes. However, as previously stated, the spacing of holes must depend upon whether or not springing is done in blasting.

The placing of the charge, which is the second item that controls a blast, brings us once more to springing and other features of the charging of holes. It must be understood that an explosive, according to the method of handling, can be a poor or a good servant. It is the explosion of gasoline in a cylinder that runs your automobile. Certainly this explosive is proving to be a good servant. Powder has been used successfully for driving timber piles into the ground without injury to the piles or those driving them. The writer once wished to throw a boulder containing fifty cubic yards of rock from a road into a river more than seventy feet away. It would have been an easy matter to have used a few charges of dynamite on the boulder and broken it up and hauled it to the river. Instead, explosives were placed under the boulder in such a way as not to concentrate too much force on any one spot, yet sufficient to hurl it through the air into the river without breaking much off the boulder, and so doing the job in the most economical manner.

Just as these explosives were controlled, those placed in a blast hole should be controlled. This means that the charge of explosive must be placed so as to loosen the maximum amount of rock and at the same time break it up so that it can be handled readily for the purposes for which it is quarried.

It should be evident that if such a charge of explosive is placed and detonated in a long, narrow drill hole, there will be, instead of one great explosion, a series of small explosions, possibly with only a fraction of a second between them, yet long enough to prevent the concerted action of all the explosive or the full force of the explosion. Charges, today, are put into holes of six inches, more or less, in diameter, that are from twenty to forty

feet long. There is not powder enough behind any foot of this hole to do the most effective work, with the result that the cubic yardage or tonnage loosened is small and the fragmentation of the rock very likely unsatisfactory.

Contrast this with the placing of a small-size charge of explosive in one compact mass, the impulse of which comes the instant the charge is detonated, and gets the full energy of every atom of the gases so generated. The result is that a larger tonnage is certain of being used. These are the results that follow the practice of springing holes.

It is true that, with the charge placed in the chamber made by the spring with deep blast holes, the rock near the top of the ledge that comes down to the quarry floor is likely to be large, but this is easily overcome by breaking up the charge and placing some of it near the top of the hole.

By this means the main charge is relieved of some of the burden and the large boulders near the top are broken up. It is even possible with very deep holes to place several small charges in the bore of the hole, to break the rock up finer. In this way it is easy, not only to control the yardage loosened, but also to obtain such fragmentation as necessary.

In blasting the drill holes they should always be well stemmed or tamped, as this increases the efficiency of the blast. This is also true of the springing of holes, but it is not always practical to use tamping in making all springs.

The amount of explosive to be used must be determined by the spacing of the holes and there is much to be said upon this part of the subject. The discussion, though, must be based upon the data already given in this article upon the theoretical and practical number of pounds of powder to use in blasting down a given yardage or tonnage. Rules will be given in the articles to follow.

What Horse Power Is Your Stack?

THIS is a question that many operators of steam power plants should ask themselves. A boiler or a battery of boilers should have a stack of sufficient diameter to make the boiler steam efficiently.

It must be remembered that a stack should be of such diameter as to allow the boiler to have sufficient draft, so that it can burn enough coal on the grate area to evaporate the proper quantity of water and secure approximately the rated horse power of the boiler. The length as well as the diameter of the boiler must be taken into consideration. The length of the breeching and stack will also govern the amount of smoke produced by the boiler. A short stack can be the cause of an excessive amount of dense black smoke with a consequent loss of efficiency.

In most cases stacks are designed and built to suit the boiler or boilers originally installed. But sometimes new boilers are added and the stack not changed. Then, too, in cases where a steel stack is used, the top may rust or burn out and the stack cut off until it becomes too short.

A stack that is too small means the burning of an excessive amount of coal to produce the necessary steam, while a stack that is too large is likely to have so great a draft that it burns coal too rapidly.

The stack must be watched as well as any other part of the plant to keep it balanced. If there is no one in the employ of the pit or quarry operator who is adequately trained and can make the necessary calculations an engineer should be employed.

If it is not possible to obtain the proper stack for a boiler plant operated with natural draft, either a forced draft or induced draft should be used.

Money Well Spent

AN operator recently said to the writer: "Some men make a great mistake by trying to hire cheap operators on machines and purchasing low priced machines. After an extensive experience I have learned that extra money paid in wages to a competent machine runner or put into a high class machine is quickly repaid. It is a fact that such money is not an expense, but an investment that pays large dividends."

These remarks are well worth reading and remembering. First as to machinery. Well designed and constructed machines cannot be sold on a pound basis, so it is difficult to judge machines by price only. The value of any machine must be based upon the range of work it will do and the amount it will do. This last will be governed by two factors: the speed of the machine and the manner it will stand up under its work.

If a machine is constantly breaking down, its rated speed counts for little, as there will be many delays not only in its operation, but the entire job will be held up, as the coordinating work must likewise cease until the machine is repaired. A crusher depending upon a steam shovel cannot work when the shovel is broken down, while the shovel must be shut down if the crusher has to be repaired.

Naturally the governing factor of any machine while it is in operation is its speed The speed sets the pace of the entire job. But to first obtain this speed the machine must be well designed and constructed of the proper materials and by first class workmanship.

To a great extent this means one must consider the experience and integrity of the men who have built the machine. A written guarantee on a machine may mean little, unless a reliable man or a complete manufacturing organization is behind the machine. A written guarantee will not keep a machine running, though it may repair it in a reasonable time. The fact that a salesman or manufacturer may swear himself blue in the face to what his machine will do and as to how it stands up to the work means nothing to the user of the machine. It is the reputation of the built machines and of standing behind his products that really counts.

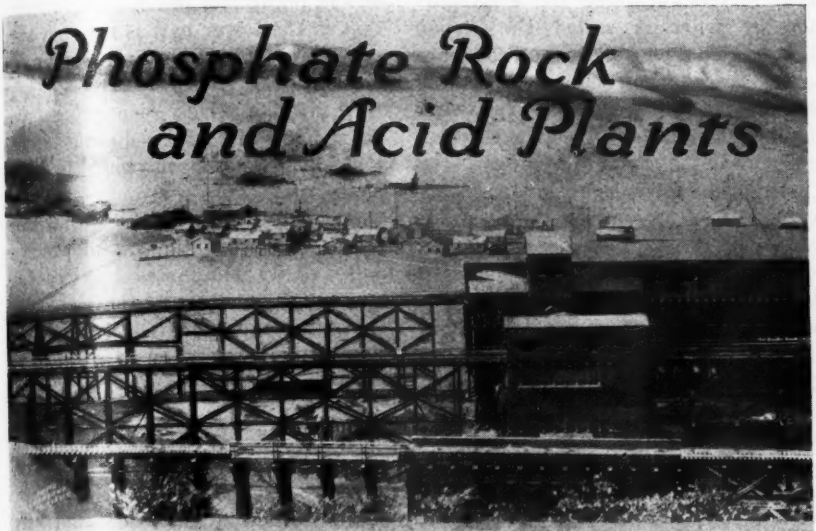
With a properly built machine designed for speed, the output must depend upon the operator. He can wreck the machine or he can make it do its maximum work without injuring it. Thus the man should be selected with care and the competent man who may be paid a higher wage, can not only pay an extra dividend on the additional salary by increasing the output, but also in caring for the machine so that it is always in running order.

A GRATIFYING feature of our trade statistics is the consistent gain being made in the production and shipment of cement. Given sufficient transportation facilities for the balance of the season, this year ought to set a new record.

The Limestone Fertilizer & Ballast Rock Corp., has been incorporated at Golconda, Ill., with a capital of $150,000, to deal in fertilizers, fire clay, etc. Incorporators: John B. King, John O. Kuge, and Thos. H. Lackland. Correspondent: John G. King, Peoria Life Bldg., Chicago, Ill.

The Fairmont Wall Plaster Company, Fairmont, W. Va., has plans under way for the construction of a sand and gravel plant at New Martinsville, W. Va. Mr. W. T. Black is manager of the Fairmont plant.

Phosphate Rock and Acid Plants



Anaconda Copper Mining Company Conducts Operations on Large Scale

THE production of acid phosphate at Anaconda, Montana, by the Anaconda Copper Mining Company, an enterprise which gives this large and important concern an opportunity to utilize one of its most abundant by-products in connection with the development of an important natural resource is an industry that has assumed quite large proportions in the section of the country in which the Anaconda Company operates. With phosphate rock mined in Idaho and sulphuric acid obtained at its big copper smelters, the company is producing a treble superphosphate which is in considerable demand in many parts of the West and abroad.

The phosphate mines are located in southeastern Idaho, at the little town of Conda, which connects with the main line of the Union Pacific at Soda Springs, eight miles away. The town itself has been built about a half mile from the mill. In it the company has constructed a number of modern homes which are occupied by employees at nominal rents. A bunk house, boarding house, superintendent's house and company offices, make up the most of the settlement, which also includes a well equipped store and a United States post office, together with a recreation hall in which motion pictures are shown, and dances and various community meetings are held. The store and the recreation hall are maintained by the company.

The site of Conda was chosen because it is the lowest elevation on the company's property, and the point from which the maximum tonnage of phosphate can ultimately be obtained by future development.

The property owned by the company comprises about 3,423 acres in Caribou County, and covers an outcrop of the phosphate formation over a distance of approximately eleven

miles, extending along the main portion of what is called the Aspen Range. The phosphate outcrops are easily traced, not so much by the presence of "float," as by following shallow depressions which extend up and down the mountain slopes, the Phosphoria formation having suffered more rapid erosion than the adjacent limestone and quartzite. In addition to this outcrop indication there is another one which is very significant, the influence of the phosphate rock itself on the vegetation along the range. The quaking aspens growing in the Phosphoria formation mature earlier in the season and have leaves of darker green color. The groves of these trees stand out in marked contrast with the light green of the adjacent areas.

The rock is largely tricalcic phosphate, a relatively insoluble compound which yields only a trifling amount of its phosphoric acid in the ordinary processes of nature. It is of sedimentary origin, lying conformably on a hard chert-bearing limestone, of Upper Carboniferous age. The components of the rock were originally deposited on the bottom of an ancient ocean. The material occurs in bedded formation somewhat like coal deposits.

There are two anticlines on the property, the axes of which run parallel with the mountain range. The phosphate rock has been eroded to a large extent from the crests of these anticlines, leaving at least three well pronounced phosphate outcrops, which lie within the boundary of the company's holdings. Over a great portion of the property, the east and west dipping phosphate exposures show an inclination ranging from 45 degrees to 90 degrees from the horizontal, a condition most desirable for economical mining and large production.

The material in the upper portions of the phosphate bed is soft, whereas that in the lower part is medium hard and breaks into small laminated blocks. The color varies from grey to brownish black, depending upon the amount of associated carbonaceous material. The freshly broken phosphate rock emits a strong fetid odor, which is probably not so much phosphoric as carbonaceous, and which is quite easily eliminated by moderate heating. Specimens of the rock sometimes show a bluish white condition frequently referred to as "phosphate bloom."

The development at present is confined to the westernmost anticline where depths of 700 feet can be obtained. The eastern dipping of the bed is worked in Adit No. 1, the western in Adit No. 2. These adits, a half mile apart, are connected by an outside tram line over which haulage is done by 15-ton storage battery locomotives, capable of hauling ten 10-ton cars a trip. These storage battery locomotives, also used in other parts of the workings, were made by the General Electric Company.

Rock taken from the workings is remarkably uniform in character. The mine product will run 32 per cent phosphoric pentoxide or 70 to 74 per cent tricalcic phosphate.

These adits are 45 feet above the railroad track level and are connected with the mill feed bins and the storage bins by large trestles. The adits are nine feet by nine feet in the clear, inside the timbers. They are heavily timbered, and are electrically lighted and ventilated by fans. From the adits, advance or development headings about six feet by eight feet (largely untimbered) are driven along the bed; these headings are subsequently enlarged, and are timbered the same as the adits. Raises for ventilation are put up about one thousand feet apart. All mining is done above the level of

the adits. Compressed-air-operated Armstrong Shuveloaders, made by Meyers-Whaley of Knoxville, Tenn., are used in the headings. Twenty-five ton rails and 2-ton roller bearing side-dump cars are used in the advance or development headings. Rock from mining operations is hauled to the mill in heavy steel side-dump cars of ten tons' capacity. These cars are equipped with standard railroad wheels and journals, couplers and hand brakes. All mine tracks are 36-inch gauge and the main ones are laid with 60 pound rails. Standard switches and cross-overs are used and the minimum radius of curvature is one hundred and fifty feet. Haulage is done with two very large General Electric storage battery locomotives, each of which is capable of hauling a 100 ton net load at a speed of 4 to 7 miles per hour, depending on the grade.

A large fireproof (gunite and steel) building houses the air compressor, the switchboards, and the motor generator set used for charging the storage battery locomotives. A similar building houses an ice plant and cold storage rooms. In addition to the above there are warehouses, a powder magazine, well equipped blacksmith and carpenter shops, and a laboratory. Power is purchased at 44,000 volts from a company which operates a number of hydro-electric plants in the vicinity. A large modern sub-station transforms this voltage to that required by the plant, mill and town. A pipe line about two miles long brings water from several springs to a storage tank, from which various mains supply the plant and town with water for industrial and domestic purposes and for fire protection. Fuel is obtained from large nearby coal mines which are operated by this company. Coal is dumped directly from the railroad cars into gunite-lined bins of about 350 tons' capacity.

All rock from the mine is dumped directly into a 450-ton feed bin. It passes from the bin over shaking grizzlies, the oversize from which is crushed to about two and a half inch size by a 12-inch Traylor gyratory crusher. Its product, with the undersize from the grizzlies, is elevated and passed over a Mitchell vibrating screen. The screened undersize goes directly into the drier feed bin, while the oversize is crushed to ¾ inch size by 22x54 inch Anaconda-type rolls, the product from which is re-elevated to the vibrating screen. From the drier feed bins the crushed rock is fed by an apron feeder to class A-12 Ruggles-Coles driers. After leaving the drier the rock goes over a shaking feeder to a chain bucket elevator which carries it over to the top of the mill, thence through a Vezin sampler and then by a system of conveyors it is deposited at any desired point in either of two bins which have a capacity of over 4,000 tons.

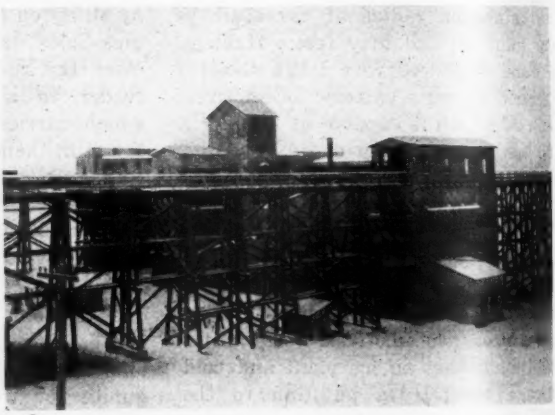
The mill building and the houses over the bins are of frame and gunite construction, and the dried-ore bins are lined with several inches of gunite for wearing surface and fire protection. Rock may be loaded directly into open railroad cars, or by means of an Ottumwa car-loader into closed equipment. The mill now has a capacity of five hundred tons per twenty-four hours. This output can be doubled by the installation of an additional drier, as the equipment is designed for at least one thousand tons' capacity.

At Conda there are storage tracks which will accommodate about a hundred 50-ton railroad cars. These tracks lead past the loading bins and over the most modern system of railroad scales. These tracks are on such a gradient that empty cars may be dropped to the loading bins, loaded there, and then taken over the track scales to the shipping tracks by grav-

ity. In addition to the above there are spur tracks leading to the plant site and to the coal bins. There is a Y at both ends of the branch, so that it is possible to turn trains where most convenient.

When the train loads of phosphate rock, dried and crushed to three-quarter inch size are received at the Anaconda, Mont., plant from the Conda mines, they are dumped into bins from which they are passed to Hardinge ball mills. This reduces the material to 60 mesh size. It is then agitated with a dilute solution of sulphuric acid to bring about the production of calcium sulphate and phosphoric acid.

When the reaction following the mixing of phosphate rock and sulphuric acid is complete, the phosphoric acid is separated from the calcium sulphate by continuous countercurrent decantation, in a set of three Dorr thickeners followed by an Oliver filter. The products of this division are clear sulphuric acid containing 19 per cent of phosphoric pentoxide, and a filter cake consisting chiefly of finely divided gypsum.

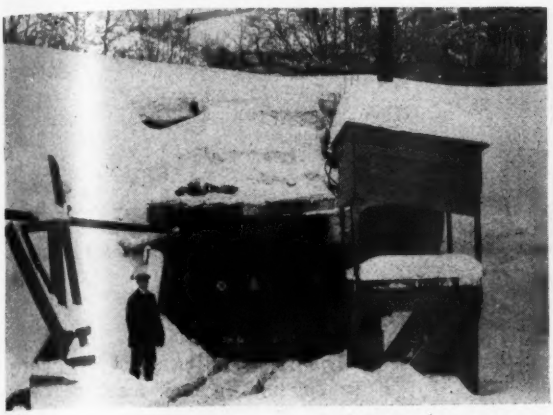


Rock from the mines is emptied into this bin for drying and crushing.

The 19 per cent phosphoric acid solution is concentrated to 45 per cent phosphoric pentoxide by evaporation in a tower of acid proof masonry, equipped with a fire-box at the bottom and a fan at the top. The 45 per cent phosphoric acid is mixed in a Pratt acid phosphate mixer with ground phosphate rock, in the appropriate proportions of two parts of acid to one part of rock. The mixture of this acid and rock is discharged upon either one of two 36 inch conveyor belts. After it has been allowed to stand 30 to 40 minutes and the acid has reacted on the rock, the mass has "set" into a damp porous solid. This is next cut off the end of the belt by a rotary cutter, and removed to McDougall-type drying furnaces, in which it is dried to a point where it contains about 2 to 3 per cent of moisture. The dried material, as it comes from the McDougall furnaces is ground in a Sturtevant ring roll mill, screened, and bagged or loaded into cars in bulk.

The sulphuric acid is obtained from the immense Washoe smelter of the Anaconda Copper Mining Company at Anaconda, Montana. Sulphuric gases derived from the smelting of ores, are trapped at the bottom of the stack, which is reputed to be the tallest brick structure in the world. This stack is built of perforated brick, laid in acid resisting mortar and has numerous built-in bands of heavy reinforced steel. Resting on massive foundations, it towers 585 feet above the ground, and has an inside diameter of 75 feet at the bottom and 60 feet at the top, with walls varying from 6 feet thick at the base to two feet at the top.

After the gases are trapped at the



A General Electric locomotive at Adit No. 2.

bottom of the stack, the dust is taken out by an extensive installation of Cottrell precipitators. The problem of dust removal, which has long been a troublesome one for acid makers, is solved with great satisfaction at this plant.

At Portland, Oregon, the Anaconda Copper Mining Company enjoys ship loading facilities that were installed by the municipal authorities with direct reference to the development of the Anaconda phosphate rock properties. The city has created a system of quays and warehouses along the Willamette river, within the city limits, which rivals that of any port in the world. There is complete equipment for handling phosphate rock, including facilities for unloading cars, discharging rock into storage bins and keeping different grades in separate compartments. Electric weighing devices and improved rock loading apparatus aid in getting vessels loaded in minimum time.

The company's building contains eight separate bins, with a total storage capacity of phosphate rock, of 18,000 tons. Each one of these bins is arranged to discharge upon an endless belt which runs in a tunnel over the bunkers, and conveys the rock through to a vessel, or deposits it on another similar belt running in a loft above the bunkers. An automatic tripper device then allows it to dump into a designated bin for storage.

The Ottumwa car unloader permits a box car of any size to be securely fastened upon it by both ends and at the sides. It is then possible to tip the car sidewise to the extent of 20 degrees, or endwise to the extent of 45 degrees, whereby all the rock in the car slides rapidly through the open doors, and is completely emptied out in about four or five minutes. Without this apparatus, unloading box cars would be so slow an operation as to render it somewhat impracticable to employ them. Their use in-

A 9-foot vein of Phosphate Rock in Adit No. 2.

Municipal Quays at Portland, Oregon. The long white building in right foreground contains the phosphate rock storage bunkers.

sures that the rock, after being dried at the mine, will reach the seaboard without being exposed to the elements, and therefore with the absorption of little or no moisture.

The triangular apparatus shown upon the quay at the side of the vessel, with spouts projecting into the latter, are ships' towers, which travel along the face of the quay, and can be located directly opposite any hatch, so that the vessel can be loaded without shifting its berth. These towers are two in number and may be used simultaneously, permitting the loading of a vessel in minimum time. The spouts are in short lengths and are arranged in telescope form, making it possible to move them about so as to discharge the cargo into any desired section of the hold. These towers are fed by long conveyor belts which carry rock directly from the bunkers to shipside.

The municipal regulations and the transportation companies both provide for liberal periods without demurrage to cover the contingency of any reasonable delay in arrival of vessels, and this whole magnificent port system is administered with an eye to yielding the most convenient and economical service to the world of commerce.

On the three pages following will be found some unusually interesting photographs of the various phases of the Anaconda developments.

Placing Bolts in Concrete

In setting up new machinery, concrete must frequently be used to give a secure foundation. When this is done there must be embedded in the concrete long bolts to fit into the base of the machines to hold them in place.

These bolts are generally placed by making a template of some kind to hold the bolts in their proper position aid embedding the whole in the concrete as it is placed. The bolts are thus held solidly.

The objection to this is that the bolts may get knocked or bent or a slight error might be made in making the template, or that at times the bolts will not fit into the base of the machine. This can be overcome by placing around each bolt a piece of pipe that will come to the top of the concrete. The pipe should be two or three times the diameter of the bolt so as to give sufficient room or play to get the bolts into the base of the machines

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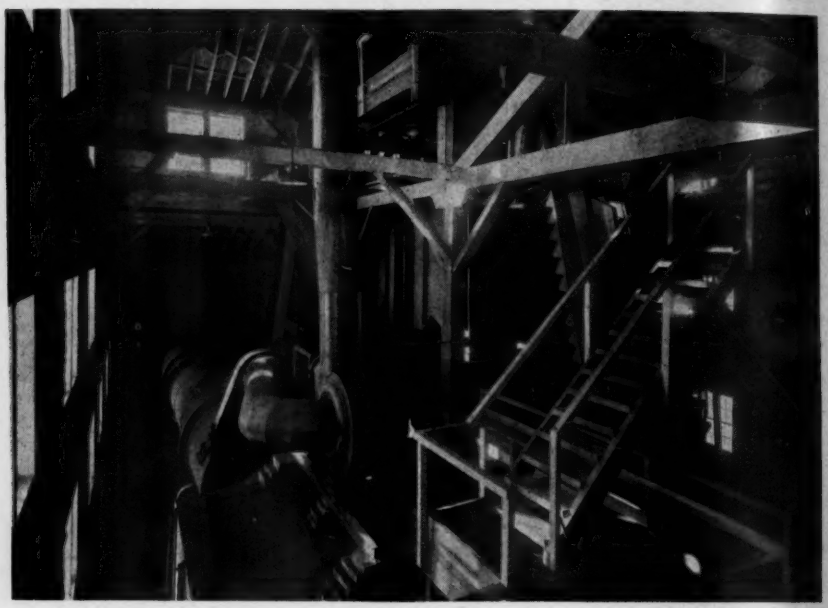
The Leicester Line Corporation, Brandon, Vermont, has been incorporated with a capital of $100,000. Incorporators: A. F. Moriglioni, Joseph P. Grant and Albert G. Ozeck.

The Deering Sand & Gravel Co., has been organized at Portland, Maine, with a capital of $50,000. President, Marco Disanto; treasurer, Richard Kennedy; clerk, Albert E. Anderson, all of Portland.

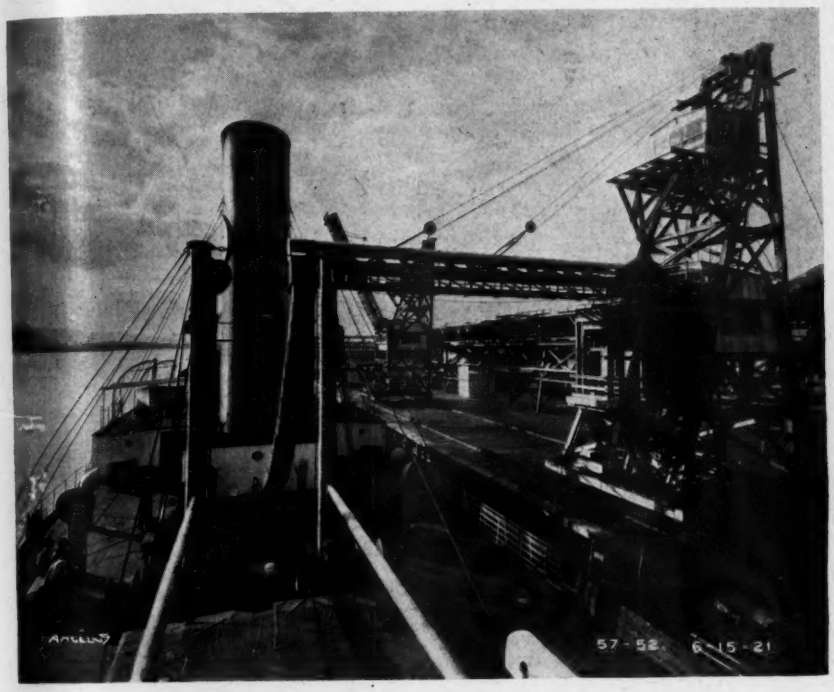
The Oneida Sand Co., of Booneville, N. Y. has formed with a capital of $150,000. W. H. Dodge, H. Barnard (attorney), F. A. White, all of Booneville.

Mill and storage bins of Anaconda Copper Mining Company at the Conda, Idaho, Phosphate Mines.

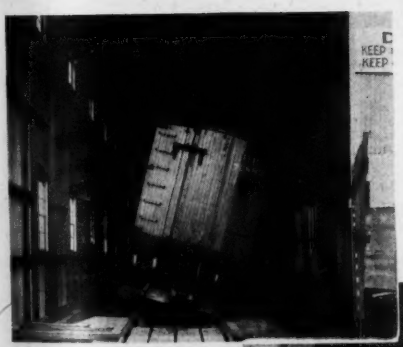


An interior view of the rock crushing and drying plant at Conda.

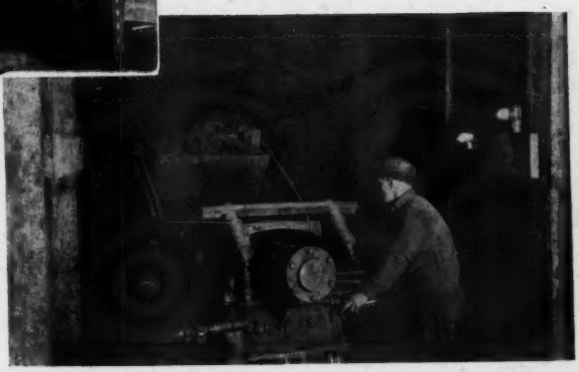
Phosphate rock is dried in minimum time to less than 1 per cent moisture content by Ruggles-Coles Drier.



By the use of these ships' towers it is possible to load rock with extreme ease from the Portland bunkers.



The Ottumwa Car Unloader empties a car in 3 or 4 minutes.



Armstrong Shoveloader hurls rock into mine cars.

PLYMOUTH
Gasoline Locomotives

Location and Capacity

Don Pedro Dam is located in California, on the Tuolumne River, and sixty miles from the Hetch-Hetchy Dam now building for the city of San Francisco.

The reservoir, when full, will cover an area of 3,086 acres, and will have a capacity of 270,000 acre-feet.

Plymouth Locomotives Share in Construction of Highest Dam in the World

The PLYMOUTH Locomotives shared conspicuously in the construction of the Don Pedro Dam, the highest dam in the world, being 279 feet from the bed of the river it retards. It is 40 feet higher than the Roosevelt Dam, and 36 feet higher than the Shoshone.

Three 3-ton PLYMOUTH gasoline locomotives delivered 1200 yards of mix daily, each making a round trip every 4 minutes.

There is no industrial locomotive so capable as the PLYMOUTH, and none so universally demanded in construction work, big or little projects. Ask us or the man who owns one before you buy.

THE FATE-ROOT-HEATH CO., Plymouth, Ohio

Aggregate Entering Above and Concrete Leaving Below at Don Pedro Dam Concreting Plant

"ONE CAR OR A TRAIN LOAD"

THE LINCOLN SAND & GRAVEL COMPANY

LINCOLN, ILLINOIS

MONTHLY BULLETIN — MAY 25, 1922 — NUMBER IV.

Customers of the olden days of 1905 and the hundreds of new ones added to our list since that time, are familiar with our slogan "ONE CAR OR A TRAIN LOAD". They are also familiar with the attractive, clear cut, enameled yellow sign LINCOLN SAND- LINCOLN GRAVEL that is placed in every car of material leaving our yards. This little sign doesn't say much, but when you see it on top of a car of sand or gravel it means it came from LINCOLN, ILLINOIS, and was produced and shipped by this company. We frequently meet people- not dealers or contractors- who tell us what an excellent idea it is and how it identifies our company and puts LINCOLN on the map.

----oOo----

Normally our biggest business comes in September and October, but this year the month of May is going to be a hummer. We still have a week to go and plenty of orders, so we will do right at seven hundred (700) cars. That's going some and it's all produced at our LINCOLN plant. We are not counting tonnage from the other pits we control.

----oOo----

We sure would be glad to see you in Lincoln as our guest and if you can get away for a day or so, let us know, and we'll try to make it pleasant for you here. If you are a fisherman of fish that swim in water, bring your rod and tackle. Last week a 8½ pound black bass was caught in our lakes- maybe you can't get a big one like that, but they're here and it's worth a try. COME ON!

----oOo----

A LAUGH UPSETS MANY AN ARGUMENT.
GOOD HUMOR OFTEN IS MORE SUCCESSFUL THAN SOLEMN INTELLIGENCE. -Exchange-

----oOo----

A TRANSMIGRATION OF A SOUL

A College sport got a little the worst for wear the other day and his "friends" put him to bed in a hotel. They covered his body with vaseline and gave him a coat of feathers from the pillow. Then they closed the windows, turned on the steam and left him. When he awoke he caught sight of himself in a mirror. "Great Scott!", said he, "In hell and a bird."

---oOo---

Things have sure been hummin' around our office during May. The contractors on the State contracts finally got started after weeks of April showers (?), and they have made up for lost time. Every day sees a trainload of LINCOLN SAND wending its way north to Towanda, Ballard, Cayuga, Ocoya and Pontiac, and slowly but surely, the miles of concrete roadway are coming into existence, and the St.Louis-Chicago Highway will soon be a reality.

---oOo---

Bulletin Helps Trade

Producer Sends One Out Monthly to Sand and Gravel Buyers

The Lincoln Sand and Gravel Company, Lincoln, Ill., is keeping itself before the people of its territory by sending out a monthly bulletin.

The one under observation consists of two mimeographed pages, the first one of which is shown herewith.

As will be seen, it is a satisfactory intermingling of sense and nonsense, calculated to get itself read by most of the people who receive it.

The Glens Falls Cement Co., Glens Falls, N. Y., is spending $1,000,000 in enlarging its plant.

Frank Farrington's Business Talks

No. 7—How Much Do You Get?

The big thing is the pay, isn't it?

It's all very well to give some thought to the work we do and to the way we do it, but after all, the main thing is the money return.

You don't question that, do you?

Don't you believe me when I say we don't really care much about how we do the work so long as we manage to hold our jobs and draw our pay?

Well now, maybe you aren't one of us job-holders.

Perhaps you are one of the kind always trying to do your work a little better today than you did it yesterday, worrying about your mistakes and studying how you can do things some different way that will save time.

What do you expect to get out of this effort to be a little better man on the job than the rest of us?

Do you think it will bring you more money, or promotion to a better position?

Maybe I am wrong and there is after all something to this idea that it pays a man to do best, pays him in real money as well as in satisfaction.

Of course I have to admit that there is some satisfaction in doing a thing well enough so you are recognized as a high class worker, but I always supposed it was foolish to do your work so well the boss would profit by it.

I've heard a lot of men say they weren't going to work their heads off just to make more money for somebody with no appreciation of what a fellow does.

Come to think of it, though, most of the fellows who have got to be real successes have been hard workers and have tried to do their work a little better every day, and have advanced because they weren't willing to stand still and be mere job-holders.

I'll tell you what I'll do if you'll turn over a new leaf and work to get into the hundred per cent class, I'll turn over one with you and we'll see how far we can get in the next, say, six months.

And I'll do more; I'll bet you that we will both be getting more money from our work at the end of the six months.

Are you game?

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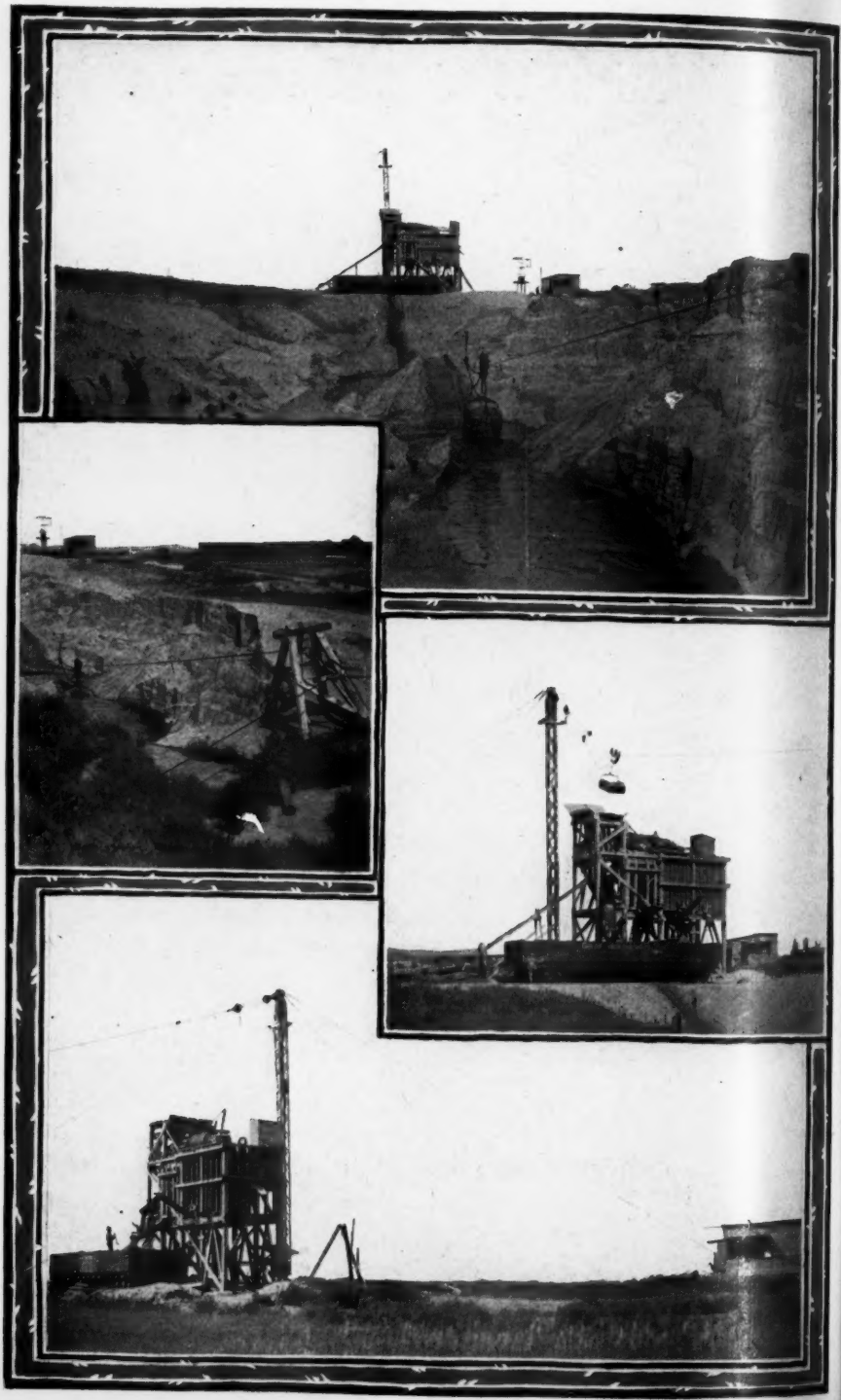


New Minnesota Gravel Operation

THE Wahpeton Gravel and Sand Company, whose main office is at Wahpeton, North Dakota, have for a number of years been operating a gravel pit and concrete block plant at Hereford, Minnesota. In 1919 they purchased at Thorosburg, Minnesota, 15 miles from the Hereford plant, 90 acres of land containing gravel. Both properties are located on the Tinta-Evansville branch of the Great Northern Railway. In the Spring of 1920, the company decided to open up the pit at the Thorosburg property, where their sand and gravel deposit of unknown depth promised to make profitable working. The land is about 20 feet above the level of Lake Pomme de Terre, in Grant County. It had never been opened extensively, and very little was known of its mineral contents.

During the first season, excavation was carried out with a Sauerman Cableway Drag Line and a Thomas hoist, loading pit-run material directly into cars. In this way the pit was opened up to a considerable extent and quite thoroughly explored. To effect a speedy operation from the bucket, the mast was placed about 125 feet across the track from the pit. It was thus necessary merely to raise the bucket above the tops of the cars to dump it. A 35-yard car has often been loaded in this manner in 45 minutes.

In the summer of 1921, it was decided to erect a screening and washing plant. To make the proper set up, the mast was moved, standing, on rollers to the plant within about 30 feet of the track and placed directly behind the receiving hopper. In addition to the digging of a few new holes for the deadmen, only one day's work was required to make this change. The hoist was merely shifted around to line up with the new location of the mast.

Gravel is now taken from a point anywhere over a span of about 600 feet. Excavating is nearly always done below water, the company's experiences indicating that this method is the best. The bucket is then dumped into a five yard hopper located above a Telsmith screen, made by the Smith Engineering Company of Milwaukee. The feed from the hopper to the screen is through an adjustable opening.

The first six feet of the Telsmith screen is a scrubbing section where the material and water are thoroughly agitated by a system of flights and lifters. The second section contains 1¼-inch round openings. All the material under 1-inch passes through these openings, after which it is caught by a sand jacket consisting of a 7-foot section with ¼-inch openings. The sand and water pass through the sand jackets, and drop directly into a sand settling tank with a capacity of 11 cubic yards. Here the sand is separated from the water, and the water taken off to a small slough. The second section of the screen has 3-inch openings, making it possible to obtain a size of gravel from ¼-inch to 1-inch, and another size from 1-inch to 2¾-inch. The company's demand is all for concrete gravel and for that reason all the product is run into one bin of about 60 yards capacity. Sand from the settling tank is dumped directly into the cars. No storage facilities are provided. The screen is driven by a 15 horsepower General Electric motor.

Material is forced from the hopper to the screen by water action. A 3½ inch pipe is divided at the mouth of the screen, one pipe entering the screen, the other going into the bottom of the hopper. Both pipes are equipped with valves and the opening at the bottom of the hopper is regulated by a slide gate operated with a ratchet. So long as the material is ex-

cavated below the water there is a fairly uniform flow, but when the sand and gravel happen to be in a dry state, the valve of the screen is closed, and no more water flows into the bottom of the hopper.

A very small percentage of the material is over 3-inch, so at the present time a crusher is not used.

Considerable pit-run material is still loaded. Sand and gravel are dumped into the screen feeding hopper mentioned above, the chute to the screen being closed off. It is possible to change from the screening operation to the loading of pit-run material without changing the dump block or anything else about the equipment. The whole operation of turning from one operation to the other requires only about five minutes. This is one reason why a special feeding device would be impractical at this plant.

Water is furnished by a well 8 feet in diameter and 30 feet deep, containing at all times about 5 feet of water. This well is curbed with concrete to within twelve feet of the top. On the curbing rest heavy timbers upon which is mounted an Amsco pump with 5-inch intake pipe and a 3½ inch discharge. This pump is driven by 15 horsepower electric motor, set on a permanent base at the ground level and connected by belt.

Material in the pit is about 33⅓ per cent gravel, 66⅔ per cent under ¼-inch. It is shipped mostly to lumber yards located in the Red River valley on the Great Northern lines. Practically all loading is into cars.

As shown in the photographs the mast used in this pit is an unusual one. The cables pass over sheaves and run through the center of the mast, thence out at right angles to the hoist.

The screening and washing plant was erected in 1921 when business conditions in the territory were very poor, and when but little construction work was going on. It was intended to supply material mostly for road building jobs. At the time of building one of the largest items of expense was the erection of the bins, which required something like 20,000 feet of lumber. The management is more than pleased with the operation of the plant and feels that it has still before it a long term of usefulness.

One of the difficult features of the operation was the wet condition of the sand. It seemed almost impossible to patch up the cars so they would not leak. This difficulty has been overcome to a large extent by keeping the sand bin almost full all the time and by carefully regulating the valve so that only two or three feet of sand would go through at a time. The sand is thus kept in a fairly dry state, but careful attention on the part of the man handling the screens is necessary.

It has been possible to operate the plant with two men while loading pit-run material, and with three men when turning out the washed and screened product. Thus, when only a few cars were going out, the expense was kept down fairly low. Three men will wash and screen and load into cars 300 tons of sand and gravel each 10-hour day. Two men will load a little more than this amount of pit-run material. These are conservative figures.

The Sauerman cableway drag line illustrated on page 82 has seen 7 years of service. It was repaired this year by the addition of a new lip and a few other parts, and looks as well as new. In fact, it appears to be good for 7 more years of service.

To secure electricity for plant operation, the company found it necessary to erect about two miles of power line. The current comes in on this line at 6,600 volts and is stepped down to 220 for use in motors.

Quality Control in Cement Manufacture

A Paper presented at the meeting of the Portland Cement Association, Atlantic City, June 27th.

By RICHARD K. MEADE, Consulting Engineer, Baltimore, Md.

CONTRARY to the general belief, the question of the quality of cement is more often a mechanical than a chemical problem—or rather perhaps one of the relation of the mechanics of the process to the chemical composition of the product. The connection between the chemical composition of cement and its physical properties is now so well understood that there are few instances where the poor quality of the cement is due to lack of knowledge of what the chemical composition of this should be. Generally speaking poor quality is due to circumstances which interfere with the attainment of the ideal composition by the chemist. In speaking of composition in this paper the term is not limited to the mere analysis of the cement, but includes the proper combination of the elements to form the so-called cement clinker.

The problem of manufacturing good clinker in laboratory quantities is extremely simple. It is merely necessary to grind finely a properly proportioned mixture of argillaceous and calcareous substances and then to ignite the mixture to the point of incipient vitrification for a sufficient time to allow proper chemical combination of the elements composing the mix. All the details of the process are well understood by cement chemists—the proper relation to be had between the argillaceous and calcareous elements, the fineness necessary to secure intimate contact and the degree of burning to promote combination are all matters of common knowledge in the industry. When it comes to handling large quantities of natural materials and to manufacturing cement economically, however, the problem is vastly complicated. To begin with the raw materials these generally vary considerably in chemical composition in different parts of the deposit and the method of accurately sampling and proportioning these materials is one of the most troublesome problems with which the cement manufacturer has to contend. The question of the degree of grinding is generally limited by the mechanical equipment provided and is always influenced by the question of economy. The problem of burning is much simpler than the other two and is usually merely one of securing experienced and conscientious kiln attendants.

These three primary operations of cement manufacture bear a general relation to each other. Some years ago I called attention to the fact that, assuming the chemical composition to be correct, there is a very definite relation between the fineness of the materials, the temperature of burning and the time at which the materials are subjected to this temperature. I can possibly best illustrate this relation by means of a mathematical formula thus

$$F \times D \times T = C$$

In which F represents the fineness, D the temperature, T the time, and C clinker (a constant quantity). It will be seen that if C is a fixed quantity the others can vary among themselves and still equal C. Thus with a coarsely ground mixture the time or temperature of burning one or possibly both, must be increased to secure proper combination. Similarly if the time in the kiln is short this must be made up for by higher temperature or finer grinding.

If the fact that the composition of the mixture of argillaceous and calcareous substance can vary is considered, another variable is added to the equation. It is, of course, well known that it is much easier to burn low lime cement than high lime cement, in which case coarser grinding satisfies. In actual practice, the details of cement manufacture, therefore, are a general compromise to suit local conditions between chemical composition, fineness of grinding and degree of burning.

I am not going to take up any time today discussing the question of fine grinding of the raw materials or the degree of burning, beyond saying that fine grinding and harder burning as indicated above will tend to correct faulty composition in some instances. The importance of fine grinding of the raw materials and of proper burning are, of course, better understood and when these are the cause of poor quality the remedy is evident.

My own experience indicates that the problem of making cement of uniform high quality is largely one of *absolute* control of the chemical composition of the mixture fed to the kilns. Occasionally I have met with a plant where raw grinding or burning equipment was insufficient, but for the most part failure to control the chemical composition of the mix has been responsible for the irregular quality of the product.

Chemical analysis of the cement does not always show the trouble particularly when this analysis is confined to a sample representing a large quantity of cement, such as a bin of several thousand barrels or a day's run because such a bin of cement may be the average of several hours of very high limed and consequently unsound cement mixed with several hours of low limed cement; the average of the two being often near the desired chemical composition but the physical properties of the resulting cement pertaining something of the undesirable characteristics of both the high limed and low limed clinker.

Such a result is quite apt to occur in the dry process, where chemical control is generally a matter of examination of a mixture already made rather than of two materials about to be mixed. It is, of course, well known to most cement manufacturers that the routine tests of the dry mill laboratory are post mortens rather than diagnosis. They are of no value so far as correcting the composition of the particular lot of raw material under examination is concerned but serve as a guide to the making of succeeding lots.

By far the larger number of mills, both wet and dry, make their mix by means of what are, in the vernacular of the industry, known as "*readings*." That is, samples of the mix are drawn from the grinding mills at stated intervals of time and in these samples the carbonate of lime is determined. If this is found to vary from the desired standard, no correction can as a rule be made in that portion of the mix which has already been prepared, and the test serves principally as a guide to the proportioning of succeedings lots, etc. When the mix is controlled by such a process, the chemist finding his mixture too high or too low in lime (as shown by the reading) decreases or increases his limestone to correct his proportions. In the dry process this often has the effect of sending his composition to the opposite extreme, with the result that while his low lime and high lime clinker will average properly very little of it is *per se* of correct composition.

In the wet process, however, an opportunity is generally given to mix the whole lot of ground material by combining the contents of several slurry

basins in one large kiln feed basin and in this way the averaging is done before the kiln is reached and hence the clinker is of correct composition.

At many dry process cement plants, the question of chemical control is largely one of good judgment on the part of the chemist rather than of chemical test. For example, let us cite the case where a limestone and shale plant is supplied with rock by one large steam shovel. The shale is regular but the various strata of limestone differ much in chemical composition. Added to this variation is also the fact that 3 or 4 feet of clay overlying the limestone is not stripped from the latter but is blasted with it. Deep well drills are used and the shots are large, each representing several months' supply of stone. All stone is sent direct from the shovel through crushers into a relatively small storage bin and the mix is controlled entirely by "readings" taken from the tube mill discharge. Let us suppose, as frequently happens, the shovel is working in the morning on clean limestone comparatively free from stripping. At noon, it encounters a limestone mixed with stripping and by night it has worked through the stripping and is back on the clean stone. What happens to the mix is this—Sometime during the afternoon the sample drawn from the tube mill shows the mix to be overclayed and the chemist accordingly decreases the shale. The orders to make this change probably reach the raw mill about the time the shovel reaches clean stone again with the result that the next sample drawn from the tube mill will show the mix over-limed, etc. At this mill, the mix would generally be wrong but for the visual inspection and good judgment of the chemist. This condition is by no means unusual and while probably not existing often in quite such an exaggerated form, does occur in a more or less modified form at many mills.

In my opinion, it is *everlastingly* to the credit of the American cement chemist, that he can make cement *superior* to any in the world with the crude methods often supplied him. He may not be as "long" on theory as his English and German confreres but for the exercise of good, hard, common sense and rare judgment he has them both, to use a slang expression, "backed off the map."

So far as quarrying methods are concerned, the steam shovel and the deep well drill are likely to stay, and it is also in most instances more economical to include the overburden in the blast rather than to strip; at the same time, it is evident, that these three improvements in quarry efficiency have increased materially in most instances the difficulty of securing a uniform mix. The big blast throws down the entire vertical face of the quarry in one jumbled heap. If it served also to mix the various beds intimately it would be of advantage, unfortunately the opposite is generally true and the beds remain almost as separate, but not as easily *segregated*, after the stone is blasted down as when in the position left by nature. In the case of the old method of quarrying by means of 16 to 20 foot benches, the beds were usually blasted down in some sort of order and could be quarried uniformly. The steam shovels also confine the stone supplied the mill to that obtainable from one or two points in the quarry, while with hand loading the stone can be obtained from almost the entire area of the quarry.

If the overburden could be intimately mixed with the stone there would generally be no objection to its being blasted down with the stone. Unfortunately this result can not often be obtained and the overburden usually lies over part of the rock only.

With these new conditions occurring in the quarry, provision must be made at the mill to take care of the irregular supply of stone and clay sent to the mill by the shovels. The influence of occasional variations in the composition of the raw materials are designed to be taken care of at most plants by storage bins of varying forms and sizes.

Usually the shale or clay supplied the mill, whether obtained by means of shovels or hand labor, is of regular composition. Sometimes with clay the moisture content needs careful supervision. A few mills use a calcareous shale in which the lime content varies over quite a range. The use of such shale always greatly complicates the problem of controlling the chemical composition of the mix by introducing two variables instead of one.

The employment of a large stone storage divided into two or more bins seems to be the most feasible method of securing a uniform raw material. In many instances, however, such stone houses are poorly designed. If we place rock continuously on the middle of a pile and draw at the same time below from the center of this, we will obtain pretty much the same stone that is being delivered to the pile and very little if any mixing will occur. Even where the discharge is not directly under the point of filling this flow of material between the two points occurs. In designing a stone house, therefore, this should be divided into at least two bins, but I do not think anything is gained by numerous small tanks or bins.

Another action which should be kept in mind is the so-called segregation of materials in the bins. If a mixture of coarsely crushed limestone is fed from an overhead source into the center of a pile it will be found that the coarse material will roll to the outside of the pile while the fine material will lie where it falls. If the pile is tapped from the center the first material drawn is almost entirely the fines while the coarse material is the last to be obtained. As the fine material usually contains the stripping and is always lower in lime than the coarse material, it will be seen that the composition of the material obtained when the pile is first tapped will be much lower in lime than that of the last portion obtained.

Many plants employ what are termed blending bins, consisting of large tanks in which the coarsely crushed material is stored. My observation has been that these bins instead of blending actually segregate, for the reason given above.

It has always seemed to me that the traveling crane and grab bucket afford excellent methods of storing limestone. With this outfit the material as crushed can be uniformly distributed over a large pile. There is no segregation of fines and coarse and the reclaiming can also be distributed over a large area. It is a simple matter for the chemist to work out for the crane operator a cycle of filling and emptying such a storage which will give uniform material and leave nothing to the judgment of the operator.

Another excellent storage is one consisting of several long rectangular and fairly deep bins filled by means of an overhead belt conveyor. This latter is in turn equipped with a traveling tripper. This tripper is so designed as to move at a regular rate slowly back and forth over the entire length of the bin and spread the material in uniform layers over this. If the bin is relatively narrow and the openings below are alternately to each side of the center line, the segregation between coarse and fine material is negligible where the stone is drawn from several openings.

For those who prefer a pan conveyor or bucket carrier to the belt conveyor, the buckets can be arranged to deposit the material at a number of points in the bin. No doubt, other methods of securing the same result are available. Where a silo storage is employed, if the number of bins is sufficient to permit it, better results will be obtained by filling or emptying a number of these at the same time by some such method as I have suggested, rather than to fill and empty in rotation.

So much for the form of storage. Another fact which should be borne in mind, is that the finer the rock is crushed, the better mixture will be obtained and the less segregation will occur in the bins. For this reason, I would suggest crushing the materials as far as practicable before storage.

For determining the proportions of the two materials where the mixing is done directly after the large stone house, two methods are generally employed. One is to obtain a sample of the contents of the bins of clay and limestone and mix the two as indicated by the analysis of this sample. The other is what is generally designated as the "reading" method and consists in mixing the two materials according to the results obtained from a determination of the carbonate of lime in the mix after this has been ground in the mill. In spite of the fact that it is apparently much the less scientific of the two methods, the second one will usually give better results. This is because of the difficulty of properly sampling material in large pieces mixed with fines and intermediates.

The only method of sampling such material which will give accurate results will be some system of crushing and quartering in several steps such as is used for ore sampling and this would involve an expensive sampling plant. As an illustration of such a plant, let us suppose that the material came from the crusher in a pan conveyor. Arrangement could be made to trip every tenth bucket into a small crusher which would crush to say 1 inch and under. The discharge from this crusher would then be sampled and the sample crushed to say ¼ inch. This ¼ inch material in turn would be sampled and the sample crushed to 10 mesh. The fine material could then be sampled and this final sample ground to the necessary fineness for analysis. It will be seen that such an arrangement would involve handling quite a lot of material.

In a cement plant using 1,000 tons of stone per day the first sample would amount to 100 tons to be crushed to 1 inch, the second to 10 tons to be crushed to ¼ inch, the third to 1 ton to be ground to 10 mesh and the fourth to 200 lbs. to be ground to laboratory fineness. It is doubtful if accurate results could be obtained with much greater fractions. It will readily be seen that the equipment necessary for such quantities is beyond that now available in cement mill laboratories.

The methods necessary for securing uniform rock at the mill are the same whether the wet or dry process is employed and to my mind the desirability of such a supply of rock of uniform composition is as great in the one process as the other. In the older wet process plants, provision was made for adding clay or marl as desired to the ground slurry before this was pumped to the kiln supply basins. Today, however, when necessary to correct the composition of the slurry, the general practice is to mix two or more tanks to give the desired results, so that as far as the mix goes, the two processes approach each other much more nearly than they did when the raw materials of the wet process were marl and clay. In the matter of chemical control,

there are unquestionably much better facilities provided at most wet process plants than there are in the general run of dry process mills. When difficulties of controlling the mix do occur in wet process plants, this is usually due to too few or too small slurry basins and kiln feed tanks or to improper or insufficient agitation.

I have always felt that the methods employed to control the mix at most dry process plants were insufficient and that a system of correcting tanks planned after those of wet process plants could be employed to advantage. If the grinding is done in two stages, such as with ball and tube mills, I would suggest the use of two sets of tanks or bins. One set of at least four, and better, six or eight tanks to be placed after the preliminary mills (ball mills) and one set of four or more after the secondary mills (tube mills). The tanks in the first set should be sufficiently large to take care of at least four hours run of the mill. The system should be provided with an automatic sampler so that the contents of each tank can be sampled as ground. Where ample rock storage had been provided to give fairly uniform rock, the four tanks could then be used in this manner. One tank would be filling, the second tank would be under test and the third and fourth tanks would be used straight, or mixed if necessary to give the proper composition. When analysis proved a tank to be of incorrect composition it would be necessary to so proportion the next tank that the two could be mixed so as to give a mixture of correct composition. The second set of tanks would receive the fully ground materials and these should also be provided with automatic samplers. They serve as a further means of correcting the mix when necessary by blending the contents of two or more tanks as the pulverized material is sent to the kiln. The mixing here is not as thorough as would occur when the two materials were ground, but still fairly good mixing would occur when screw conveyors were used to carry the mix from the tanks and considerable mixing would also be effected in the upper part of the kiln before the material began to form into balls.

At some plants, it would no doubt be found most convenient to use such a series of tanks for mixing. That is, to grind the materials separately to 10 to 20 mesh before the mixing is done. In this case certain tanks would be set aside for limestone and certain tanks for clay and both materials would be sampled automatically and mixed according to the analysis of these samples. It is comparatively easy to secure an accurate sample of 10 or 20 mesh material, while it is extremely difficult to obtain anything which will properly represent material crushed only to one inch. So that this system of sampling, analyzing and mixing will do with 10-mesh material but will not give satisfaction with one-inch material. The statement that the finer the material, the easier it is to sample accurately will hold good for all materials.

No doubt various modifications of this system would be devised to suit local conditions. For instance, at certain plants it might be found best to mix partly by analysis and then to do the correcting by adding to the contents of the tanks as drawn a small amount of clay or limestone ground to 10-mesh. I am not trying to outline a plan to be followed by all plants, but merely to indicate lines along which such a system may be worked out. The cost of operating such a system would be low and the initial investment small. I believe the saving in other lines aside from quality would pay for the installation and upkeep of the system. Such saving would include fuel required to burn over-limed mix, power to grind under-limed clinker, labor due to greater kiln outputs, greater life of kiln linings, etc.

In the earlier paragraphs of this paper, I have shown how the various steps in the process of cement manufacture bear one on the other. From this it will be evident that if there are short comings in one step these must be made up for in the next. If the composition is irregular, the grinding of the raw materials must be carried to the degree of fineness necessary to give sound cement from the high lime mixture as well as from the low lime. Every chemist knows that where the lime is high, much finer raw grinding is required than where it is low or even normal. In order to make sure of sound cement, the chemist must therefore grind finer where occasional runs of high lime material are encountered than where the mixture is constant. The proper fineness of the raw materials are therefore influenced to some extent by their composition.

The proper burning of cement is largely one of feeding the material and fuel to the kiln at a regular rate. If the composition of the mixture is constant, it is evident that if the material is fed to the kiln at a regular rate and the kiln is kept at a definite temperature and revolved at a constant speed the resulting clinker will be uniformly burned. The trouble with the burning is, first, that the composition changes, requiring a higher temperature or a longer time in the kiln and, secondly, that the rate at which both raw material and coal are fed to the kiln is subject to violent and sudden fluctuations, or in other words, both coal and raw material "flood." I believe that where trouble with the burning results much of this can be eliminated by designing proper feeding arrangements for both raw material and fuel. The irregularities due to change of composition come gradually and can be kept up with, while the feedin of the raw material is usually sudden and the extra load of material occasioned thereby is hard to catch and properly burn. The arrangements for feeding slurry to the kiln, where this is done by positive means such as buckets and scoops, are excellent and something of the same sort is desirable in the dry process.

The qualities most desirable in cement are soundness, strength and uniformity in the rate of setting and hardening. All are dependent to a marked degree on chemical composition, the fineness of the raw materials and the burning. These three steps are therefore the ones which must be under peerfect control if quality cement is to be produced. I regard the chemical composition as the keystone of the arch. Unfortunately, it is the step least under control. While there are many plants where unsound or quick setting cement is a rarity, even here there might be an appreciable improvement in quality by a closer regulation of chemical composition. Most cement chemists are playing safe, as it were, rather than attempting to attain any ideals. Perfect control of the composition would enable them to make cements much higher in lime than they do at present, with the result that their clinker would be easier ground and the resulting cement stronger and more uniform in setting and hardening qualities.

Fire of unknown origin almost completely destroyed the plant of the Pennsylvania Glass Sand Company, in Morgan County, West Virginia. The loss is estimated to be between $60,000 and $75,000.

The Britton Crushed Stone Corporation of Rochester, N. Y., has been incorporated with a capital of $50,000. Directors are: W. N. Britton, Ward N. Britton and H. P. Rupert, all of Rochester.

Producing Glass Sand Efficiently

A VERY interesting and efficient glass sand plant is that of the Juniata White Sand Co., at Mapleton Depot, Pa. This concern, under the direction of Mr. Wm. O'Connor, superintendent, and Mr. Chas. C. O'Connor, assistant superintendent, is profitably producing 250 tons of crushed and dried silica sand each ten hour day.

The deposit that the Juniata company is working is part of a deposit which runs as far as Berkeley Springs, West Virginia. The quarry has a face about 600 feet in length and 275 feet in height. Stratification is inclined at about 45 degrees, and all strata are about the same for silicious content—that is to say, through the deposit the material runs 99.75 per cent pure silica. The material occurs in places with yellow clay which washes out easily. A little iron cement and a faint trace of aluminum are also encountered.

Material is secured from the face by blasting, and later breaking up by air drills into one-man size stones, which are hand loaded into dump cars. Stones as large as 40 feet in one direction are occasionally encountered. The broken stone is loaded on two-yard V-type side dump cars made by the Koppel Industrial Car & Equipment Co., of Koppel, Pa., and by the Biehl Iron Works of Reading, Pa. At the quarry are employed 15 to 20 men, ten at loading and the others as drill operators on the tram system. Cars are drawn by horses up to the face and when loaded, drop back by gravity to an incline, where the loaded cars dropping down a short trackway, pull up the empties. The whole operation is controlled by a brake at the top of the incline. After the loaded cars are dropped down from the quarry they are made up in trains of eight, and picked up by an 18-ton Baldwin locomotive which carries them along 2¼ miles of track to the crushing and drying plant.

When the cars reach the plant they are pulled up a runway by friction hoist as shown in one of the accompanying photographs. Arrived at the top they are dumped from the side and fall by gravity to a 12x20 inch Lewistown jaw crusher which reduces the material to about 2½ inch stones. Located a little below the crusher is a Lewistown 9 foot chaser mill with stationary pan and wheels which revolve on power furnished by a bunty shaft, wheel and pinion. It is readily seen that, in this work, the equipment must be built with special reference to its ability to withstand the severe abrasion of very sharp silica sand. The mill is equipped with a 5-inch high carbon steel bottom in eight sections. Wheels are mounted with a tire 10x5 inches with 42 inches inside diameter. When abrasion has reduced this tire to a point where its effectiveness is impaired, the tire is replaced.

The product of the chaser mills goes through perforated plates in the sides of the mills to a 6-foot x 30-inch 10-mesh revolving screen made of No. 20 brass wire. Everything passing through the screens passes on to a set of eight Lewistown helical screw washers, which agitate the sand thoroughly in running water and deposit it on a 20-mesh conveyor belt, running at 35 degrees to the horizontal, up to a level for carrying to the draining floor.

The operation of stocking the draining floors is handled by a scraper which stocks piles of sand wherever desired. What is run one day is drained the next, that is to say about 14 hours are given for the running off of the water acquired in the washing process.

The conveyor belt feeding the drainage floor runs the entire length of the building. It also serves the purpose of supplying the dryer from the draining floor. By the scraper method mentioned above the material is spotted in any position and by use of a portable drying elevator, is raised again to the conveyor and brought to the dryer. These drying elevators are manufactured by the Juniata Company. As shown in the illustration they run at about 45 degrees on 30-pound rails at top and bottom with steel buckets mounted on fibre belting, powered by an electric motor driving the pulley. This elevator is 19 feet in height with a wood frame, built of 3x6-inch material. The conveyor belt is 12 inches wide with 10-inch buckets. Motor is a 6-inch pulley with a 5-inch belt, leading to an 18-inch driven pulley, geared 4 to 1 at the top. Motor is 5 h.p. General Electric, operating at 220 volts, A. C.

The portable elevator discharges on a belt conveyor which carries to a Lewistown single steam dryer, built of a series of pipes through which the silica drops and is dried at the rate of 25 tons per hour. The method used in feeding the dryer from the belt

Inclined Runway Up Which Cars Are Hoisted Into Plant

A Trainload of Glass Sand from the Quarry

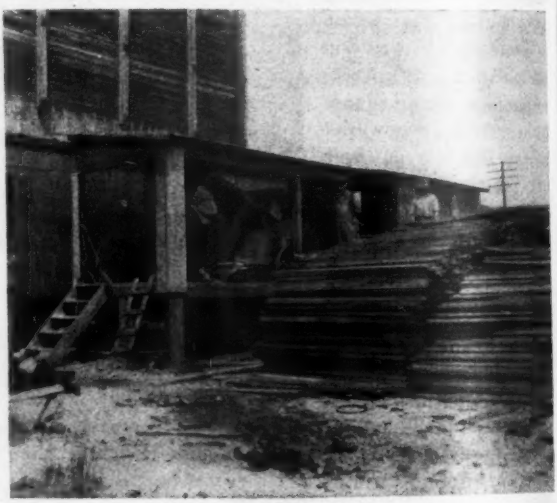
Portable Drying Elevator Feed Conveyor Belt from Draining Floor

is by scraper, the same as in feeding to the draining floor. These scrapers are set at 45 degrees to the conveyor, and can be dropped on the belt at any point. The dryers run by steam from a 100 horsepower Erie boiler, operating at 100 pounds pressure. It is equipped with Hetzler & Zuch shaking grates. After drying, the sand drops through a hopper onto an 18-inch conveyor belt. The feed to this belt is adjustable. The material is then conveyed to a 10-inch belt with 8-inch buckets, and reaches the top of the dry sand storage bin, where it is passed through 16-mesh screens, made of No. 24 wire, and goes to dry sand storage.

Loading is done with a Link-Belt loader, which passes the dry sand to cars that are thoroughly cleaned and prepared.

Water for the plant comes from the Juniata River through a sump, from which a centrifugal pump with 8-inch intake and 6-inch discharge forces it to the washers and the boiler. This pump is run by a 25 h.p. General Electric motor, running at 220 volts, D.C.

Lewistown Dryer Removes All Moisture from Material



A Link-Belt Car Loader Used in Shipping Department

The Concho Washed Sand Company of Oklahoma City has just been organized and charter filed with the Secretary of State. The company is incorporated for $10,000 and the incorporators are: Moore C. Hess, Rae M. Hess and H. D. Bland. The company will handle sand and gravel.

The White Sulphur Lime & Stone Co., White Sulphur, Ohio, has been purchased recently by the C.C.C. & St. Louis Railway company for $135,000. The property consists of more than 100 acres and was bought by the railroad in order to procure ballast for the new roadbed between Columbus and Galion.

Liquid Oxygen Explosives

Although the use of liquid oxygen explosives has not yet made much headway in the United States, experiments made with such explosives by a metal-mining company at Pachuca, Mexico, operated by American capital, promise quite satisfactory results, according to observations made by a representative of the United States Bureau of Mines. From the beginning of the entrance of the United States into the World War, efforts have been made by George S. Rice, Chief Mining Engineer of the Bureau of Mines, to have liquid oxygen explosives tried out practically in this country. Owing to the fact, that no manufacturer in the United States makes oxygen liquefying plants, the use of these explosives in America has been quite limited. The development of this innovation so far has been largely German, and in Germany oxygen liquefying plants are manufactured in various sizes in complete units of apparatus and containers.

Since the war the only extensive development outside of Germany has been in the Lorraine iron mines where the Germans installed apparatus, and aditional apparatus has been put in by the French. One company in Lorraine is mining its entire annual output of 1,500,000 tons of iron ore by the use of these explosives. This company has developed a cartridge of its own on which it has received patents, and has applied for others. It is claimed that the cartridge is an improvement on the German cartridge. The Germans use for brisant effects, soot; and for slow heaving effects, wood pulp. Either fuse or electric detonators can be used for igniting the charge. The Germans have now developed a method of placing the electric detonator in the bottom of the hole in a special container and have been able to fire large rounds, it is claimed as high as 28 shots at a time.

Magnesite in 1921

Reports received by the United States Geological Survey, Department of the Interior, from producers of magnesite show that the quantity of crude magnesite sold or treated during the calendar year 1921 was 47,904 short tons, valued at the mines at $510,177. This quantity was less than half that for the year 1920, and smaller than that for any year since 1916. California was the only producing State, and nearly all the product was calcined for use as plastic material. The output of domestic magnesite for use in refractory products was very small.

In contrast to the large decrease in domestic production there was an increase in imports, which consisted chiefly of crude magnesite. The apparent consumption of magnesite in the United States in 1921 was equivalent to about 113,500 short tons of crude magnesite, 58 per cent of which was imported. This consumption is the lowest recorded for many years, probably largely because of conditions in the metallurgic industries, which consume, in the form of refractory material, most of the magnesite used.

Truck Company Prepares Survey

The Duplex Truck Company of Lansing. Michigan, prepares for prospective users of motor trucks a transportation survey which is compiled from data supplied by the operator, on the effect that the installation of a Duplex truck would have upon the efficiency of the operations.

A specimen survey compiled for a sand and gravel company contains a seven page analysis of the conditions surrounding the work at the particular pit in question. Figures supplied by the operator are used to calculate the present cost per yard of loading, hauling and unloading one cubic yard of sand. Other sets of tables built around the idea of using a Duplex truck show how, after making more liberal allowances for dead time than the operator does, this expense is very materially lessened.

A number of other pages included in the bound copy of the survey are devoted to testimonial letters from present users and to mechanical specifications of the type of truck recommended. All Duplex trucks drive from four wheels, and have a number of other unique mechanical features. Literature and information may be obtained by addressing the Dupex Truck Company, Lansing, Michigan.

Buyers Numerous in East

Items of Interest Throughout the Trade—Market Notes

(By Our Eastern Correspondent)

The continuance of heavy construction operations, both in the line of buildings and roads, is developing strong activities in the sand, gravel and crushed stone markets, and the advent of summer, with hot weather, has had no immediate effect upon sales or production. Prospective buyers are numerous and constantly on the lookout for first grade stocks, and supply dealers are showing no hesitancy in creating a fair amount of reserves.

Distribution is keeping pace with sales, and large tonnages are reaching all active sections of the New York and New Jersey districts. Road operations in these states are also making heavy calls on the available supplies and no letup is in sight. The past month has brought marked improvement in the situation as regards prompt deliveries, for with the resumption in the New England producing districts, selected material is far more plentiful.

The production end functions satisfactorily: While labor is not very abundant, the supply is sufficient for immediate demands, and producers are not having much trouble on this score; at the same time, good skilled labor is not easy to secure, and every effort is being made to hold such men "on the job." The output from the Long Island districts is on the increase, and the same holds true with the New Jersey producing districts, including the Raritan River section. There is a noticeable advance in the employment of labor in the last noted section.

The prices of sand, gravel, broken stone and kindred materials hold very firm, and there is no indication of any recession in prevailing levels. The strengthening tone of the market rather indicates advancing figures as the months progress. The market stability is leading to more satisfactory and uniform trade, and there is an encouraging aspect in the situation for good future business for producer and dealer.

In the wholesale trade, gravel holds at $1.75 in cargo lots, both for ¾ and 1½-inch sizes; a year ago, a $2.50 level prevailed. Retail dealers are asking $2.75 for the material, either size, delivered on the job at Brooklyn and New York.

Building sand continues at $1.00 a cubic yard to contractors and dealers at New York, in carload lots. Retailers are quoting $2.00 for the material delivered to convenient points in the city. The best grade white beach sand is priced at $4.50 a cubic yard, delivered.

Crushed stone shows no change from the figures set forth in the last issue of PIT AND QUARRY; 1½-inch stock, in cargo lots, f. o. b. city, holds at $1.65 a cubic yard, while 3-inch material is just a shade higher, or $1.75 a cubic yard. The available supply is sufficient for immediate call. The local building supply dealers quote $4.00 a cubic yard, delivered, for selected crushed stone.

Portland cement is enjoying a heavy call, and large quantities of this material have been coming into the local market during the past month, with almost as rapid distribution. Quotations are firm and present levels, if anything, will trend upwards, owing to the scarcity of fuel at some of the mills. Dealers at New York are paying $2.10 a barrel in carload lots, alongside dock, without bags. Wholesale material, delivered, maintains at $2.40 and $2.50 a barrel, while retail consumers are paying $3.25 a barrel, with established bag rebate of 10 cents.

Warehouse prices on lime show no change. Common hydrate material is quoted at $12.50 a ton; finishing hydrate varies from $15.80 to $16.75. Common lump stock is from $2.75 to $3.15 a barrel, wholesale, and finishing lime, $3.70 a barrel.

McConnell & Co., Inc., stone contractors, New York, have acquired property on East 134th Street, extending through to East 135th Street, and fronting on the line of the New York, New Haven & Hartford Railroad. A complete stone-working plant will be installed on the site, with conveying, hoisting and other machinery.

The Oneida Sand Co., Booneville, N. Y., has been organized with a capital of $150,000, to operate local sand and gravel properties. The company is headed by W. H. Dodge and H. Bernard. It is represented by F. A. White, Booneville.

The Chazy Limestone Corporation, New York, N. Y., has been formed with a capital of $300,000, to operate

limestone properties in the vicinity of Lyon Mountain, N. Y. A complete quarrying plant will be installed. W. H. Williams, Lyon Mountain, heads the company.

The Central State Coal & Rock Co., New York, has been organized with a capital of $100,000, to operate rock properties in different localities. The company is headed by G. H. Hamburg, W. J. and K. Sieger. It is represented by A. M. Hamburg, 63 Wall Street, New York.

Alexander Pelli & Co., 509 East 120th Street, New York, have commenced the erection of a new marble works on property recently acquired on Albion Street, Elmhurst, L. I.; the plant will be 105x160 feet, and will be equipped with machinery for cutting, grinding, polishing, etc. It is estimated to cost approximately $55,000.

Angelini & Ditullio, Inc., New York, N. Y., has been organized under state laws to operate a local stone works. The company is headed by G. Angelini, C. Ditullio, and S. Allichi, 355 East 149th Street, New York.

The Board of Estimate, New York, has decided to use a granite superstructure for the new county courthouse, instead of limestone or limestone trimming, as initially considered. The contract for the work has been awarded at a price of $2,275,000 to the George A. Fuller Construction Company, New York. It is said that the work will insure capacity production at a number of granite properties receiving portions of the order. Crotch Island granite from Maine will be used both for the base and the portico.

The Dubin Granite Quarry Co., Brooklyn, N. Y., has been incorporated under state laws with a capital of $100,000, to operate a granite quarry. The company is headed by F. Lauro, D. Porazzo and J. G. Glumbalvo, 44 Court Street, Brooklyn.

Sand and gravel operations in the Raritan River section of New Jersey are reaching an encouraging status. Clay miners in this district are, for the most part, producers of sand and gravel, and operate subsidiary plants for this purpose. Large shipments are going forward from Perth Amboy, South Amboy, South River and other points, and incoming orders insure activity in this line for some time to come. The Whitehead Brothers Co., is among the leading interests in this section, specializing in high grade sand for different purposes.

The National Fireproofing Co. is maintaining active operations at its quarry properties at Port Murray, N. J., giving employment to a large crew of men. The output is being used at the local manufacturing plant.

The H. S. Lingle Sand & Stone Co., Carrolltown, Pa., has been organized with a nominal capital of $5,000, to operate sand, gravel and crushed stone properties. The company is headed by James B. Drury, Fred J. Fees and H. S. Lingle, all of Carrolltown. The last noted will act as treasurer of the company.

The Storb Crushed Stone Co., operating at Pool Hill, near Pine Forge, Montgomery County, Pa., has tentative plans under consideration for the rebuilding of its rock crushing plant, recently destroyed by fire with loss of about $60,000, including equipment. Practically the entire structure was destroyed and considerably ruined. This is the second serious fire that the plant has been subjected to within the last three years. Horace Storb heads the company.

The Hopewell Hills Quarry Co., operating near Birdsboro, Pa., has been doing some heavy blasting at this quarries. A recent blast, using about 20 tons of dynamite, destroyed a cliff about 250 feet high and 560 feet long, loosening a mass of about 350,000 tons of rock. It is estimated that this charge will keep the present working force busy for close to one year. Extensive production is under way at the plant and large shipments are leaving the quarries.

Charles Evans, operating a quarry at Clifton Heights, Pa., has been subjected to direction by the local court, covering the manner of blasting used at the plant. The order is the result of a petition arranged by property owners in the vicinity of the quarry, asking restraint of the plant unless some manner of blasting might be used that would protect neighboring lands. The court in approving of the petition says that the vibrations due to the blasting must not in any way cause damage to properties in this section; otherwise, the operation of the quarry must be discontinued.

The Decarbonated Lime & Stone Co., Waynesboro, Pa., is maintaining active production at its local quarry and large shipments of material are leaving the plant.

Peak Loads At Mills

Cement Manufacturers Making Effort to Maintain Capacity Output

Operations in the Lehigh Valley cement district continue under peak conditions. Practically all mills are on the producing list, and leading companies are bending every effort to develop and maintain capacity output. The railroad strike at its present status has had the effect of marked increased call for immediate shipments and deliveries, in order that purchasers may be sure of transportation facilities for the movement of the material. Up to the present time, the railroads have been able to supply all the cars that are needed, and heavy distribution has been made without difficulty.

The fuel situation is now growing to be a matter of serious concern. As recorded in previous issues of PIT & QUARRY, the cement mills in this section stocked up well in advance of the strike, but the supply is rapidly being depleted. It is estimated that the next four weeks will find a number of plants with surplus coal stocks exhausted, bringing about unavoidable curtailment. This condition is being met with strong resistance, and keen efforts are being made to replenish the bituminous coal supply.

The coal situation is having a direct effect in regard to prices, and if it becomes necessary to secure fuel at exorbitant figures, it is likely that the increase will be added immediately to the present mill base. At the same time, producers are working energetically to avoid an advance. It is believed that present quotations in the different parts of the country are equitable, and these bring a fair return to the producers.

Mill prices in the Lehigh Valley section are holding at the recently established figure of $1.90 a barrel, and there is no difficulty in making sales at this level. Excluding the fuel scarcity referred to, the cost of production shows no tendency to decline, and a lower base is hardly to be expected.

The Lehigh Portland Cement Co., Allentown, Pa., has placed its three mills in the vicinity of New Castle on a capacity basis for the first time in nine months. Operations at Mill No. 2 were advanced late in June, with the employment of an increased working force. Other plants of the company in the Lehigh Valley section are running full and heavy shipments are leaving the plants. Orders on hand insure maximum production for some time to come. Employes of the company recently held their fifteenth annual outing at Neff's Park, Allentown, the event taking the form of a clam bake. More than 300 workers were present and plant superintendents and officials, including Colonel E. M. Young, first vice-president, Alonzo Walters, treasurer, and D. E. Ritter, superintendent. The affair was a marked success and assisted materially with music by the Lehigh Portland Band from the Ormrod mill.

The Lilly White Cement Co. is maintaining active production at its new quarry near Nazareth, Pa., giving employment to a good number of workers. The outlook is decidedly favorable for continuance, and it is likely that the output will be increased in the weeks to come. The company is also busy at its mills..

The Atlas Portland Cement Co. is running full at its Northampton mills, and a number of additions recently have been made to the working force. Large shipments are going forward both by rail and motor truck, and new business is highly favorable for capacity operations for some time to come.

The Coplay Cement Co., Coplay, Pa., continues on the active list, with employment of regular working force. The coal situation in this section is not very favorable, but it is unlikely that the mill will be affected for a number of weeks to come. Rather "fancy" figures are being asked for coal at this time.

Other producers running under heavy output in the Lehigh Valley district include the Giant Portland Cement Co., the Hercules Portland Cement Co., and the Bath Portland Cement Co. In nearby sections, the Alpha Portland Cement Co., is engaging at capacity at its various mills.

The mills prices of cement in different producing districts hold substantially at the advanced levels established in June, set for in the last issue of PIT & QUARRY. At Universal, Pa., a rate of $1.85 a barrel prevails in carload lots, less bags; Hudson, N. Y., is holding to a $2.00 base; Buffington,

Ind., $1.80; Mitchell, Ind., $1.95; Leeds, Ala., $1.85; Kingsport and Richard City, Tenn., $1.95; Fordwick, Va., $1.95; Mason City, Ia., $1.95; La Salle, Ill., $1.70; and Hannibal, Mo., $1.85.

A notable consumer of cement during the present season is the Southern Power Co., Charlotte, N. C., which is using about 50,000 tons for new power plant construction and other building work. The shipments are being handled by the Frank Line, New York, through the port of Wilmington, N. C. The average cargo is running about 96,000 bags, or approximately 4 tons.

The Aetna Portland Cement Co., Union Trust Building, Detroit, Mich., is pushing construction work on its new plant at Essexville, Mich., and foundations for a number of the initial buildings have been laid, including main cement mill, power house, machine shop and other structures. The plant will represent an investment of close to $1,000,000, and will be placed in service just as soon as it is completed.

Stocks Find Ready Sale

Pittsburgh Operators Continuing on Good Status—News Notes

By Our Pittsburgh Correspondent

The sand and gravel market at Pittsburgh, Pa., shows no curtailment in activity and producers are continuing operations at a good status. Large quantities of material are reaching the local port from nearby points and find a ready sale. Sand-diggers are undergoing regular inspection, usually current at this season of the year, and the fleets of the leading companies are being maintained in fine condition.

Prices show no change of any appreciable extent, and there is a firmness in prevailing levels that makes for good market stability. Chushed stone is selling at $2.85 per cubic yard, f.o.b. city, both for 1½ and ¾-inch sizes. Retail, the material is bringing about $4.50, delivered on the job. Allegheny River sand holds at $2.40 a cubic yard, while first grade washed gravel is quoted at $2.00 a cubic yard on the dock, f.o.b. float, the material is selling for $1.60 and $1.65. Portland cement is operating under a good demand, with a wholesale level of $2.02 a barrel in carload lots, f.o.b. city. Local supply yards are asking around $3.00 for the material delivered.

The Iron City Sand Co. is operating its digger, "Independent" at Twelve-Mile Island in the Allegheny River, and is making heavy shipments from this point to the Pittsburgh market. The company is also active in the Neville Island district and is using its towboat, "Iron City" between this locality and the Pittsburgh port. The "P. M. Pfeil" is another towboat of the company that is engaging under good distribution at this time.

The Keystone Sand & Supply Co., is continuing under increasing production in the Neville Island section, and the towboat "Victory" is in active service to this point. The company has recently chartered the towboat "Clyde" of the Clyde Coal Co., and is using the vessel for tows of sand and gravel from the Coraopolis district.

The Rodgers Sand Co. is running a good fleet to the Pittsburgh port, with the towboats "Twilight" and "Sweetcake" doing the bulk of service. The company's dredger is in active service on Fourteen-Mile Island in the Allegheny River, producing a fine grade of sand and gravel.

The J. K. Davison & Brother Co., dealing exclusively in Allegheny River sand and gravel, has its steamer "J. K. Davison" in daily service, bringing large quantities of material to the local market. An effort is being made to create additional reserves, but with the prevailing call for production, this is proving a difficult task.

The management of the new Rockdale Lime Co., West Stockbridge, Mass., are making plans for the erection of a building 40x240 feet, which will contain a rotary kiln to be used in the making of fine finishing lime. This building will also contain crushers for the grinding of the calcium stone into land plaster or phosphate.

The Cisco and Northeastern Railway Company of Breckenridge, Texas, has awarded contract to the Ranger Crushed Stone Company of Ranger, Texas, for crushed stone sufficient to ballast the railway track from Cisco to Breckinridge. The contract involves a consideration of $65,000. The Ranger Crushed Stone Company owns and operates immense stone quarries near Ranger.

New Plan Proposed

Sand and Gravel Association Will Vote on New Constitution Soon

There will soon be held, in Chicago, a constitutional convention of the National Association of Sand and Gravel Producers, to pass upon the new constitution proposed by the reorganization committee. This committee was headed by Mr. John Prince, of Kansas City, and included some more of the very best men in the industry.

The new constitution changes the name of the organization to the National Sand and Gravel Association. There were some members of the committee in favor of making it the National Mineral Aggregate Association, but modification of the present name was retained even though the article regarding membership says that "any person, firm or corporation of the United States or Canada, engaged in the production of any mineral aggregate shall be eligible to membership."

The object of the association is stated as follows:

"To promote and extend the use of the products of the industry.

"To provide an organization for the cooperation of the members and the coordination of their efforts with those of other Trade Associations and with Governmental Agencies in the furtherance of all projects affecting the industry.

"To establish and to maintain the highest standards of business practices, customs and usages among its members, and to protect the interests of the industry."

The constitution provides for the division of the country into sections, the number which seemed best to the committee being 26, although the number of sections was not provided for in the constitution.

The management of the association is to be vested in a board of directors, one director to be chosen by each district and three directors-at-large to be elected at the annual meeting of the association. Five members of the board of directors are to be chosen, who together with the president and secretary-treasurer of the association shall constitute an executive committee, which shall actively conduct the affairs of the organization. This executive committee is empowered to secure the service of an executive secretary to act under its direction.

The annual meeting has been changed by the new constitution from a democratic to a representative body, each district being entitled to select five delegates and five alternates to represent the producers of that district, although any member of the association is to be entitled to the privileges of the floor.

The board of directors is to comprise a nominative committee to place in nomination on the first day of the annual convention at least one member for each office. Any five members of the association may make additional nominations by filing the same with the executive secretary in advance of the election.

It is planned that all assessments and dues shall be paid in regular monthly installments.

Instructions on Dynamite Use

A set of instructions recently prepared by Arthur LaMotte, Chief of the Technical Bureau of the E. I. du Pont de Nemours & Co., shows graphically correct methods of loading dynamite and the most efficient manner of preparing the explosive for work. Together with the outlines of the correct methods are shown the incorrect practices, some of which are pretty widely followed.

A misfire in large blasting operations is a serious and dangerous matter. In such operations it is extremely important that special attention be given to the preparing of the detonator for the explosive charges.

Du Pont engineers in the field state that some explosive users continue to employ incorrect methods, although the subject of loading dynamite cartridges has been given attention for years. These engineers are striving to convince users of the mistake of continuing practices that may develop dangerous conditions, and which are actually more expensive by reason of the fact that they do not get the most efficient results from the dynamite.

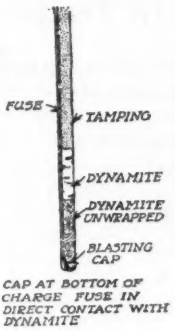
The instruction sheet prepared by Mr. La Motte is shown on opposite page.

The Universal Portland Cement Company has started work on an addition to its plant at Duluth, Minn.

IMER AT TOM OF CHARGE

Here is one WRONG way:

For instance, the cap with fuse should not be placed at the bottom of the hole like this as the side spit of the fuse would be likely to set fire to the dynamite.



CAP AT BOTTOM OF CHARGE FUSE IN DIRECT CONTACT WITH DYNAMITE

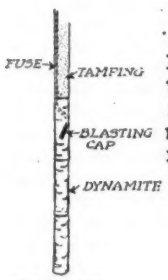
- here is another

This is also bad practice as the cap is pointed away from the charge instead of toward it and the fuse is also likely to set fire to the dynamite before the cap explodes.

MER IN CENTER CHARGE

- and another:

Even the middle of the charge is not the right place to put the primer as the top cartridge does not receive the full force of the cap and the fuse may ignite the powder that touches it.



FUSE LACED THROUGH CARTRIDGE

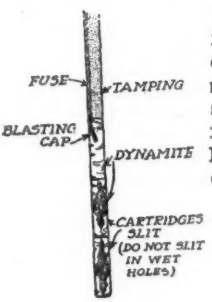
- still another

Lacing the fuse through the priming cartridge is bad practice. It nearly always lets the fuse side spit into the dynamite.

O TAMPING. PRIMER IN CORRECT OSITION)

Another WRONG way:

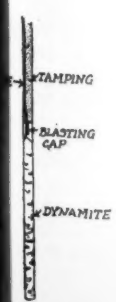
This kind of loading, without tamping is expensive and inefficient as the top cartridge wastes most of its force blowing out the hole. The Bureau of Mines reports that tamping increases the effectiveness of high explosives enormously.



- and another:

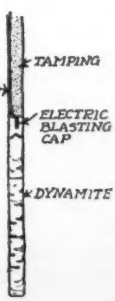
If the holes are full of water the cartridges of dynamite should not be slit as water affects nearly every kind of dynamite except gelatin.

LOAD DYNAMITE THIS WAY AND SAVE MONEY.



The RIGHT way:

THIS WAY, WITH THE CAP IN THE TOP OF THE TOP CARTRIDGE, POINTING DOWN TOWARD THE BULK OF THE CHARGE, WITH LOTS OF TAMPING AND NO PART OF THE FUSE TOUCHING THE POWDER WILL GIVE YOU A PERFECT SHOT EVERY TIME.



- another RIGHT way:

OR EVEN IF YOU FIRE ELECTRICALLY, YOU WILL GET BEST RESULTS THIS WAY AS THE ELECTRIC BLASTING CAP IS PLACED SO AS TO EXERT ITS MAXIMUM DETONATING EFFECT ON ALL THE EXPLOSIVE IN THE CHARGE.

Selling Goods In Texas

Sand and Gravel Business Keeps Early Season Stride

By Our Dallas Correspondent

The sand and gravel business in Texas continues good as building operations show no decrease and highway construction and street paving take on added impetus. Sand and gravel dealers everywhere report difficulty in keeping up with orders, while prices show no decrease.

Dallas County is going forward with its road building program, having just authorized construction of the belt highway entirely encircling the city of Dallas and connecting all the cardinal roads radiating from the city. This highway will be about 45 miles in length and will be chiefly of gravel construction. Most of the gravel used in its construction will be purchased by the county on competitive bids.

Dallas County is also doing other road-building, several stretches of the cardinal roads running north and south and east and west from the city being now under construction, and gravel and sand are being used in large quantities in this work.

Building operations in the city of Dallas continue on a large scale. Several large buildings, including the 12-story Medical Arts Building, the Dallas Athletic Club Building of 12 stories, the 12-story Jefferson Garage building and several others now under way are of reinforced concrete construction, and sand and gravel is being used in large quantities in pouring the walls and floors of these buildings. Most of this sand and gravel is being purchased from Dallas dealers, and is being hauled to the job and delivered by the dealers.

Dallas is also carrying forward an extensive street paving program, which is calling for large quantities of crushed stone, gravel and sand. The street paving program was made possible by the bond issue voted some time ago for street improvements. Under the plan for street paving in Dallas the property owners pay for the pavement in front of their property, leaving only the street intersections for the city. With the proceeds of the $750,000 bond issue recently voted, the city is able to carry forward a large street improvement program. Several streets are now being paved, and others are being surveyed: In all, it is estimated that something like 40 to 50 miles of paved streets will be made possible under the proceeds of the bond issue.

One of the deterrent factors in the sand and gravel business in Texas at this time is the recently enacted truck law, which levies a heavy tax on large automobile trucks operating over the county and state highways. The tax levied is graduated according to the load hauled, and as sand and gravel dealers have been employing large motor trucks with large capacity, the burden falls unusually heavy on them. In some instances it is intended that the tax shall be prohibitive and prevent the operation of the excessively loaded trucks.

Sand and gravel dealers have been ignoring the law, being advised by their attorneys that its provisions are unconstitutional and that, when a case is taken to the appellate courts, the law will be declared void. Drivers of motor trucks in such instances are being arrested and charged with violation of the truck law. A test case is now on appeal and it is expected that a decision will be had before many months, when this situation will be cleared.

The law as enacted specifically exempts farmers from operation of the law, and on this ground it is claimed that the measure is class legislation and violates the provision of the State Constitution against class legislation.

While gravel and sand dealers generally have ignored the law and have continued their hauling without interruption, the efforts of officers at enforcement of the law have interfered with the business of these dealers somewhat, and the final disposition of this case will be welcomed.

Gravel prices in Dallas remain firm, at $1.50 to $2.00 f.o.b. cars at the gravel pits. For delivery on the job, prices vary greatly, depending on distance of haul, nature of roads, conditions of unloading, and other factors.

The V. V. Coal, Gravel and Transport Co., Zanesville, Ohio, has been organized with a capital of $100,000. Organizers: J. O. Sloan, W. L. Jamison, J. M. Vernon, J. MacVernon and R. H. Valentine.

Limestone Fellowship

Agstone Association May Finance One at Ohio State University

At the recent Cleveland meeting of the board of directors of the National Agstone Association, one of the important topics of discussion was with regard to the establishment of a limestone fellowship at Ohio State University. Regarding it, the following letter from Prof. Firman E. Bear of the University was read:

"We find considerable interest in limestone demonstrations on the part of the New York Central and Baltimore and Ohio railroad companies and have just had a very interesting conference with Mr. Hill of the N. Y. C. lines on this matter. We also find that the limestone producers are very much interested in supplying amounts of limestone for this purpose. We find, however, that there is considerable difficulty involved in connection with working with individual producers in demonstrations. We appreciate the help and good will of the several limestone producers but we prefer not to conduct demonstrations with limestone secured from a single company. Our interest lies in demonstrating the value of limestone in general and not in some product in particular. For this reason it has seemed best to cooperate with the railroads or with an association of producers and to reserve the right to choose the limestone best suited to the conditions of the test.

"By reason of the interest in this problem we venture to suggest to the National Agstone Association that they finance a limestone fellowship at the Ohio State University covering a period of three years, the graduate student employed to take as the subject of his dissertation, 'Fineness of Limestone as Related to Its Effective Use.' This student's time for three summers (perhaps four) would be devoted to demonstration work over the state in the use of materials now produced by the several companies and his winters for three years to the laboratory study along the line of his dissertation. It would, of course, be necessary for him to take certain supplemental courses in the university to satisfy the requirements of the Ph.D. degree which he would be assumed to secure at the end of the three-year period. The results of the demonstrations and of the research would belong to the university but would be accessible to anyone concerned and copies of the results obtained would be supplied to the National Agstone Association for such distribution as it might see fit to make. The railroads would be asked to provide free transportation to the limestone and to the student.

"I am asking that this matter be brought to the attention of the several members of the association doing business in Ohio in the hope that such a fellowship may be financed and that our demonstration work over the state may be made more effective.

"A suitable man for this work can be secured from among those majoring in this department or coming here from other institutions. Such a fellowship should pay from $700 to $800 per year and should provide traveling expenses other than railroad fare to the extent of from $200 to $300.

"If such an arrangement can be made you can be assured that this department will bend its energies in the direction of seeing to it that the investment is well made insofar as it is possible."

The matter will come before the annual meeting in January for final decision.

Hope to Cut Rates

The trade in Indianapolis is considerably interested in another opportunity to cut overhead, which will be considered by the Indiana public service commission next fall in a further reduction of power rates and rates to the larger users of electric current for lighting purposes. Attorneys now are working on petitions that will call for reductions. Some reductions were made this year, but, according to leaders in the movement for still lower rates, the first reduction was not sufficient. The state commission, which has charge of rate regulations, has announced that it will entertain such petitions after October 15, which is the time set by the commission as being sufficient to deserve the effect of present rates on the finances of the power companies.

Approve 90% Loading

Sand and Gravel Association Will Have Constitutional Convention—Other Washington Matters

By Our Washington Correspondent

The Trunk Line Association has granted the request of the National Association of Sand and Gravel Producers, to reduce minimum car load weights on sand and gravel to a basis of 90 per cent of the marked capacity of the car instead of the full basis of marked capacity as heretofore. It was stated at the offices of the National Association in this city that the new arrangement will become effective early in September, possibly as early as September 1.

Similar applications have been filed with the Western Trunk Line Committee at Chicago and the Southwestern Freight Bureau at St. Louis. As the request was granted by the Trunk Line Association it is felt that the other two organizations will also make a similar grant. As can be readily understood, this decision affects every producer of sand and gravel within the territory of the Trunk Line Association, and it is believed by officers of the National Association in Washington that the industry will be greatly benefitted by this decision.

The constitutional convention of the National Association of Sand and Gravel Producers will be held in Chicago probably the early part of September. It is already known that the attendance at this convention will practically equal the attendance at the regular annual convention. The new constitution recently adopted at Chicago at a meeting of the reorganization committee will come up for consideration and will be finally disposed of one way or another. It is not believed that there will be serious opposition to the adoption of the new constitution.

At the regular quarterly meeting of the executive committee of the National Association of Sand and Gravel Producers held here July 21, President Alex W. Dann sounded an optimistic note for the future of the industry. The committee considered and disposed of a number of routine matters.

Construction and maintenance of highways, motor roads and truck channels during 1922 will total, in round numbers, about $680,000,000—about $53,000,000 more than last year—according to figures just made available through government agencies. Federal aid will account for about $125,000,000 of this amount, including $75,000,000 appropriated by Congress and accumulations from various appropriations; state funds derived from several sources will account for some $275,000,000 and county and local funds for the balance. Expenditure of this enormous amount of money on the nation's transportation system is held to indicate the determined effort being made in a majority of the states to solve the highway transportation problem and at the same time bring about one of the aims of the unemployment conference by providing work for hundreds of thousands of men. Under the federal highway act, approved last fall, it was provided that the states should furnish the money with which to meet federal aid or that they should have control over the funds so used.

A program of national forest highway construction involving an outlay of approximately $10,000,000 for 1,170 miles of roads in 23 States has been approved by Secretary of Agriculture Wallace. The program will be financed largely from the forest highway fund provided by the Federal highway act. About $6,500,000 will come from this source, $1,000,000 from other national forest road appropriations, and the rest will be contributed by States and counties. The funds and mileage are for forest roads of primary importance to States, counties and communities, and it is expected a large number of the projects will be completed this season. Practically all the roads to be built are parts of state or county highway systems and will in most cases connect with and extend the system of Federal aid highways covering the entire country. In some cases, the Department of Agriculture says the new construction will provide roads through mountain regions of national forests hitherto penetrated only by pack trails. In addition to the major road projects, about $5,000,000 will be expended by the forest service on minor roads and trails required primarily for the protection of and administration of the national forests.

The committee on tests of the American Society of State Highway Officials met with the officials of the Bureau of Public Roads June 26 and 27 to consider standardization of specifications and tests for road materials. The purpose of this meeting of representatives from all sections of the country was not so much to lay down rigid rules as to harmonize the general practice. Standardization, taking into account local conditions, is being brought about by a series of meetings between officials from groups of States and engineers of the bureau. The present activity of highway officials along this line is most encouraging for road building. A few years ago the general tendency was toward individuality in each States, without much opportunity for exchange of ideas and knowledge. Today the tendency is in the other direction, and a better solution should be reached when the problems are discussed at meetings of the best highway engineering talent of the country.

In building a road liberal allowance should be made for future increase in traffic, says the bureau. A traffic count conducted by the bureau in co-operation with Tennessee officials on a number of roads in Davidson County, in which Nashville is located, shows surprising facts when compared with a similar count in 1916. During this period automobile registrations have doubled, while the number of motor vehicles on the road is five times as great as in 1916. In 1916 horse-drawn traffic had decreased only slightly in volume and constituted 16 per cent of the traffic, motor vehicles constituting 84 per cent. Observations in this and other counties lead to the conclusion that volume of traffic may increase in much greater proportion than the number of motor vehicles and will also depend to a large degree on the condition of improvement of the road and on the economic conditions in the adjacent territory.

Thomas H. MacDonald, chief of the bureau, has left Washington for an extensive inspection trip of federal-aid road work in the western states. He will give particular attention to the planning of the federal-aid system of highways, for which meetings will soon be held with officials from various groups of states, and wishes to familiarize himself with conditions on the ground. While in the west Mr. MacDonald will inspect several of the national forest and road projects where the bureau is carrying on some of the most spectacular road construction to be found in the country today.

The Federal Trade Commission has issued orders to cease and desist against the Good Roads Machinery Company of Kennett Square, Pa., the Galion Iron Works & Manufacturing Company, of Galion, Ohio, the Stockland Road Machinery Company of Minneapolis, the Austin-Western Road Machinery Company of Chicago, the Russell Grader Manufacturing Company of Minneapolis, and the Acme Road Machinery Company of Frankfort, New York, all engaged in manufacturing and distributing road machinery and kindred products. The commission's orders require the respondents to discontinue the practice of giving or offering to give to officers or employees of any political sub-division of a state or a municipality, money or other gratuities for the purpose of inducing them to purchase the respondent's products.

Demurrer to Injunction

Following the presentation of arguments by attorneys, Judge Moll of Superior Court in Indianapolis, has taken under advisement a ruling on the demurrers filed some time ago by the International Cut Stone Contractor's and Quarrymen's Association, Inc., the Bedford Stone Club Auxilliary, Inc., and fifteen of the seventeen affiliated companies and individuals in Indianapolis, Bedford, Bloomington and Ellestville. to the anti-trust injunction suit brought against these concerns by the attorney general of Indiana in March.

Frank Davidson, representing the defendants, contended that admitting the allegations of the complaint, the facts were not sufficient to constitute the offense for which the defendants are sought to be held liable. At the request of the attorney general, Judge Moll dismissed the case as to the Hoosier Cut Stone Company and the George Doyle Corporation, two of the companies named in the original suit. These two companies were not parties to the demurrers, but had filed motions to make the complaints more specific.

Boom Hits Louisville

General Construction Work Forges Ahead Very Rapidly

By Our Louisville Correspondent

Two things have contributed to busy times all the first half of the year in this territory both for quarry people and for sand and gravel people, and the prospects are that they will keep busy through the summer and fall at least. These two things are busy times in road building, and a general construction boom in Louisville.

Some idea of what kind of a building boom we have enjoyed in Louisville may be had from the fact that building permits for the first half of the year totaled ten million dollars and this was the biggest figure of the most optimistic predictions early in the year for the whole year, and here it has been topped during the first six months. June alone showed a million dollars' worth of permits and there are no signs of let up, so the sand and gravel people have had a good local trade from building operations as well as a good demand for road and street work and a fairly good trade in car lot shipments which is still keeping up.

The new freight rates help some, as they reduce the freight cost to some important centers enough to make quite a difference on a low cost item like sand and gravel. Naturally, too, there has been a good volume of shipping since the new rates went into effect, but for that matter there has been a good volume of car lot demand right along. Both the Ohio River Sand Co., and the E. T. Slider Co. plants on this side of the river report a busy season and a good volume of business.

When asked about the effect of new freight rates, and what is happening in the way of car supply since the railway strike, manager J. E. Lloyd of the Louisville yard of the E. T. Slider Co., said they had had a good demand for out-of-town shipments right along, and so far have not had car troubles, but they are expecting to have trouble any time in getting cars and making prompt shipments because the strike is hampering transportation considerably.

The E. T. Slider yard on the New Albany side has also had a busy season, and the indications are that it will keep busy all through the late summer and fall.

R. B. Tyler says he is operating three quarry plants right along in connection with road contracts, but there is nothing doing yet in commercial quarrying at his plant near Louisville, neither is there anything doing in ballast. Some of the plants in the state he says are doing a fair amount of ballast work, and those connected with highway building are all fairly active.

The State Highway Commission at Frankfort has recently announced plans for still more road building to involve an outlay of half a million dollars so it looks like road building is to continue active for several years. Incidently there is a report from the capital that the revenue for motor vehicles this year will pass the two million dollar mark which shows how the building of roads helps the automobile and truck business and the state revenues therefrom.

Plans are on foot now to have an "Own Your Own Home" Exposition at the Jefferson County Armory the week of October 23-28. The show will be given under the supervision of the Louisville Real Estate Board, and managed by Phillip N. Arnold and William N. Knatz, who have put on similar shows in other cities.

The cement plant of the J. B. Speed & Co., at Speeds, Ind., suffered damage to its brixment department July 13th from fire to an amount estimated at $125,000. The fire damaged did not interfere with the production of cement in the main plant, but it does necessitate a rebuilding of the brixment part of the plant.

Karl B. Grahn, head of the Louisville Fire Brick Works, which operates fire clay properties in the eastern part of the state and is the most prominent refactories institution south of the Ohio River, died July 8, at the age of 77. Mr. Grahn came to Louisville in 1887 and started the Louisville Fire Brick Works, having previously operated fire clay mines at Grahn in the eastern part of the state. He accumulated considerable wealth as well as built up the largest fire brick institution in the south.

The Estill Sand and Gravel Co., Louisville, Ky., has increased its capital from $10,000 to $35,000.

"It's a Big Country," Says A. P. S.

Secretary Sandles Back From Hitting the Long Trail

Secretary A. P. Sandles is back on the job at Columbus, O., secretarying as vigorously as ever. He has been on a long western trip, about which he says:

"There is lots of country out West. At Victoria, B. C., we attended the greatest good roads convention ever held in the Dominion of Canada. Every province of the Dominion was represented. Good roads and more people are the great needs of Canada. Victoria is one of the pleasing pastime pleasure spots of all the world 365 days in the year. The land of flowers and good health. Their big ships sail West for the Far East. There you enjoy the balmy summer climate in daytime and sleep under covers at night. There good fellowship is knee deep and gives the visitor a royal welcome.

"In our own Western states the good roads sentiment is dominant everywhere. The automobile, motor bus and motor truck form a trinity of utility and pleasure. Out there, long, dry, hot weather causes floods. Melting snows flush the rivers. Two genial gentlemen from England were on the train with me. They were impressed and amazed with the size of America. One of them said, 'This is a 'ell of a country. You ride two nights and a day and then you "aint" there.' The Columbia River Highway Drive is well nigh worth in itself a cross continent journey. Concrete, asphaltic concrete, macadam, surface treated, willite and warrenite roads are in evidence."

No, he hasn't said a word about that governorship job.

The Mount Pleasant Stone Company, Mount Pleasant, Iowa, is making extensive improvements and additions to double capacity. New quarrying equipment, shovels, washing plant and screening plant will be added and complete operations laid out on a modern basis. Waller Crow, Incorporated, 327 South La Salle Street, Chicago, are the engineers in charge of all work and specifications.

Deposit of Magnesite in Southern Nevada

A massive deposit of magnesite of unusual character that has recently been brought to the attention of the United States Geological Survey promises to yield a large and readily available supply of this material. The deposit lies in Clark County, Nev., in the valley of Muddy River, one of the tributaries of Virgin River, a few miles above the town of St. Thomas. The material has been known for some time as kaolin, and successful experiments for utilizing it as a porcelain clay are reported to have been made, though they have not yet resulted in the exploitation of the deposit. The recognized outcrops have been located as mining claims, and some preliminary exploration and development work has been done. A side track on the St. Thomas branch of the Los Angeles & Salt Lake Railroad, about 3 miles northeast of the northernmost group of claims, offers a readily available railroad connection, and the station has been named Kaolin from this deposit.

The so-called kaolin is stated by the Geological Survey to be in fact a magnesite and was deposited in a highly magnesian sedimentary bed, a part of a regularly stratified series of sedimentary beds exposed by steam channels that cut across a low ridge at the upper edge of Muddy Valley. The deposit forms a chalky-looking bluff, dazzling white in the bright sunlight. The material is porcelain-white, fine grained, and massive, is remarkably free from foreign material, and has the structureless appearance and conchoidal fracture that are generally characteristic of magnesite. It is not so hard as the more typical magnesite, and it crumbles more rapidly on exposure to the weather.

The deposit is included between tilted beds of conglomerate and sandstone below and shale above. The lower contract is sharply defined, but the magnesite grades up into the overlying beds. The purer part of the deposit consists of beds aggregating at least 200 feet in thickness. Within the section of purer material there are a few bands of sandy matter, but these are minor in amount and apparently almost negligible, as they could undoubtedly be avoided in mining.

"Bucket Facts" for Bucket Users

"Bucket Facts" also known as Pamphlet No. 619, of the Hayward Company, makes good reading for the producer who is thinking of buying a bucket now or at a later date. The pamphlet tells briefly about Hayward buckets and the importance of putting the right bucket in the right place. This may not seem to make so much difference, but the Hayward Company claims that one of the outstanding features of its forty years of practical experience is the necessity of building a Hayward bucket for every digging and handling need, for every type of operating machine.

Orange peel, clam shell, drag scraper and electric motor buckets are described and the uses to which each type might best be put are set forth. If further information is required, the company promises the co-operation of Hayward engineers to help solve any bucket problem. This service is offered without obligation to the buyer.

Copies of Pamphlet No. 619 may be secured from the Hayward Company, 50 Church St., New York City.

All-Steel Drilling Outfit

A most important advancement in blast hole drilling equipment is the new all-steel blast hole drill manufactured by the Armstrong Manufacturing Company, Waterloo, Ia.

The Armstrong company has a successful record as drill manufacturers, covering a period of more than half a century. Their first drilling rigs were of the simple water well type; but since it has been proven that large blast holes are the most economical for quarrymen, they developed a machine that is particularly adapted to this class of work.

For ten years or more they have been putting out rigs made partly of steel and partly of wood. In these rigs the steel parts were bolted together; but use developed the fact that bolts will not hold rigidly enough to be entirely satisfactory.

The new all-steel outfit is the result of more than three years of constant study, work and improvement. It is built entirely of steel, except the band wheel and two sets of the larger bearings. The frame is built of angle steel on a heavy channel steel frame or chassis and there are no bolts in any part of it—every joint is hot riveted. It is built like a steel truss bridge and found to be true and rigid even after being subjected to excessive and unusual warping or twisting strain.

It is equipped with either electric or gasoline power at the option of the buyer. It has an all-steel derrick fitted with the Armstrong patents covering the use of wire line instead of Manila cable. This item in itself is one worthy of special mention especially when you consider that a three-fourth inch wire line will last four to five times as long, thus reducing the cable cost per foot drilled to a minimum.

This wonderful machine is built in tractor models only—weighs eight tons and is as easily handled as any ordinary truck or tractor.

The Armstrongs have made still another departure from conventional usage and that is in advertising the price ($3,750, delivered), freight prepaid, at the buyers' station, anywhere east of the Rocky Mountains! The price including cable and complete tool equipment for blast hole work—the buyer is saved the trouble and expense of lining up tool equipment and can put the rig to work immediately upon arrival. The company's faith in this rig is indicated by an offer of sale on a thirty days' trial.

A New Free Handbook On Blasting

"Eliminating Waste in Blasting," a new handbook now being distributed by the Hercules Powder Company, contains material that should show the wide-awake quarryman many ways in which he can save money on his blasting operations. The subject matter includes accounts of the way in which some progressive companies are eliminating waste, all stories accompanied by sketches and photographs. There are chapters on "Planning the Work," "Drilling," "Choice of Explosives," "Advantages of No. 8 Blasting Caps," "Use of Stemming," and "Preventing Waste in Firing." It is the intention of the company to supplement this book from time to time with bulletins as new information becomes available. Free copies may be obtained by writing the Advertising Department of the Hercules Powder Company, Wilmington, Delaware.

Bulletin On Improved Synchronous Motors

"Synchronous Motors" is the title of Bulletin No. 1124, of the Allis-Chalmers Manufacturing Co., published in May, 1922. In this publication is included a good description of the synchronous motor—its advantages and applications.

Synchronous motors have been on the market and in use for many years, but not until recently, when power companies discovered their systems overloaded with wattless magnetizing current, has the synchronous motor been serious considered for many of the classes of service for which it is eminently suited. The increasing demand has led to a careful investigation so that the modern synchronous motor is a machine of really special construction and not merely an alternator with a squirrel cage winding added to the rotor poles. They are now built with very satisfactory "starting and pull in torque characteristics" which also helps to account for the increasing demand in recent years.

Throughout the book are many splendid ilsutrations of the synchronous motor adapted to various industrial uses, under conditions where it is belted, coupled or direct connected. A number of views show the motors in cement plants and in installations where they are serving to drive air compressors. Other sections of the book include descriptions, profusely illustrated, of the various parts of the synchronous motor, and of the motor as a whole. At the end of the book is an amount of engineering data on the use of the synchronous motor for the improvement of the power factor. This will be of special interest to engineers who are always interested in this important feature of their work.

Copies of Bulletin No. 1124 may be secured by addressing the Allis-Chalmers Co., Publicity Dept., Milwaukee, Wis.

Carroll Solid Weld Steam Shovel Chain

Carroll solid weld steam shovel chain is produced with solid welds which are reheated and worked until they become as solid in texture as any other part of the link. By reason of the lap there is more material at the weld. As this material is solid metal, the weld is claimed by the manufacturers to be the strongest part of the link. The manufacturers further claim that Carroll solid welds do not break or come apart, that the links are formed from the finest double refined iron obtainable, and that all the chain makers in their employ are skilled mechanics.

Power Hoe a Versatile Tool

The Link-Belt power hoe is described and illustrated very thoroughly in book No. 444, a recent publication of the Link-Belt Company. In this book, by the use of well written text and clear half tones and line drawings, the company has shown to good advantage the field of application of the power hoe, and the advantages that follow with its use.

The company draws attention to the fact that the power hoe is not a substitute for all other types of elevating, conveying, unloading, reloading, storage and reclaiming equipment, reminding the reader that its manufacturers have practically every type of material handling equipment, that they are in a position to show the limitations of the tool, and to recommend it for just those conditions under which it will function best. Many successful installations have been made where mine-run and small sizes of coal, also sand, gravel, cement and crushed stone are stored and reclaimed.

The manufacturers claim for this, too, that it is applicable to large or irregular shaped storage that cannot be served by other equipment; that it is suitable for storing either indoors or out; that it entails minimum installation and operating expense; that it does not require a skilled operator, and has no parts which can become seriously damaged by misuse; that it is furnished in sizes to meet any required storage area or capacity. The necessary equipment for a complete installation includes driving machinery and drums, leads and balance sheaves, scraper or power hoe, and steel cable.

Copies of book No. 444, describing the power hoe, may be secured by writing the Link-Belt Co., 910 S. Michigan Av., Chicago, Ill.

Fuller's Earth Figures

Activity in This Industry Not So Great Last Year

The great activity in the fuller's earth industry that began in 1915 and continued until late in 1920 was checked in 1921 by the depression in the petroleum industry, the output of fuller's earth declining 18 per cent and the value 21 per cent in 1921 as compared with 1920. The demand for fuller's earth increased late in 1921, however, and the outlook for 1922 is so good that some new deposits in Georgia and Pennsylvania may be developed. Notwithstanding the considerable decrease in both output and value, the output in 1921 was the largest recorded, except that in 1919 and in 1920, and was nearly three times as large as that in 1913. The imports decreased in even greater proportion than the production—49 per cent in quantity and 46 per cent in value.

Fuller's earth has been reported in Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New York, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and Washington, but in 1921 it was produced only in Alabama, Arkansas, Florida, Georgia, Massachusetts, and Texas.

Fuller's earth produced and marketed in the United States, 1916-1921.

Year—	Operators reporting sales	Short tons	Value at mines	Average price
1916	10	67,822	$ 706,951	$10.42
1917	11	72,567	772,087	10.64
1918	14	84,468	1,146,354	13.57
1919	10	106,145	1,998,829	18.83
1920	12	128,487	2,506,189	19.51
1921	12	105,609	1,973,848	18.69

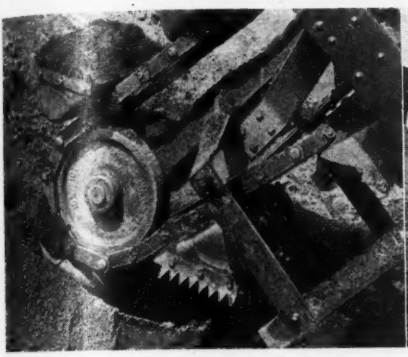
The small number of producers makes it impossible to publish totals for some States without disclosing individual operations. All the production came from the Southern States, except that of one operator in Massachusetts. Florida was the leading producing State, as it has been since the beginning of the industry, and reported 57,268 tons, valued at $1,109,823, or 54 per cent of the total output and 56 per cent of the total value. Georgia was second and Texas third in both output and value. These three States reported 99 per cent of the output and value for 1921.

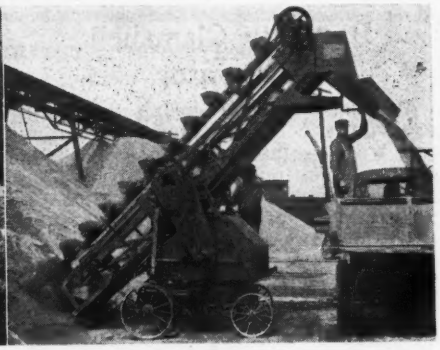
The imports of fuller's earth, which had been gradually increasing for many years prior to the World War, naturally fell off during the war but increased in 1919 and 1920. In 1921, however, they decreased materially and reached the lowest quantity since 1900, and were only 39 per cent as great as those of the record year, 1914. The value, however, showed no such decrease, owing to the increase in prices received for the earth. Of the imported earth, 95 per cent was wrought or manufactured.

Fire at Louisville Cement Plant

On July 13th, the brixment plant of the Louisville Cement Co., located at Speeds, Indiana, was destroyed by a fire which continued for eight hours and caused damage estimated at from $75,000 to $100,000. Hot cement in hoppers over the top of the main brixment building is believed to have started the blaze. Parts of the plant destroyed were all old structures. The main cement plant, valued at more than $1,500,000, was saved. As soon as the company has found out the extent of the damage done to equipment, the plant will be rebuilt. The loss was fully covered by insurance.

The broad field of mineral fillers is sadly lacking standardization, according to Oliver Bowles, mineral technologist of the Bureau of Mines. Many users of mineral materials have very indefinite knowledge of their requirements either in color, grain size, grain shape or chemical composition. The standardization of fillers is practically an untouched field, and such standardization accomplished through a comprehensive study of the subject would not only promote better manufacturing processes, but would be of material benefit to producers. It is claimed by one producer that the cost of purchasing special screens to satisfy the requirements for odd sizes of his finished product for one customer destroys most of the profit obtained from grinding roofing grade talc.





A Real One-Man Loading Machine

THE Link-Belt Power Swiveling Loader is the superior of any machine we have ever built for the loading of materials from ground storage—and we believe it is the superior of any similar machine on the market today.

The loader must be seen at work to be fully appreciated. The swiveling feature which is patented makes it possible to maintain a loading speed as fast as required on any job.

It is really a one-man machine, no other helper is required when loading any material that will flow. The Link-Belt Power Swiveling Loader feeds from the pile, swivels and elevates all at one time, or it can accomplish any of these operations independent of the others—and all at the will of the operator, conveniently located on the platform.

Send for our Book No. 357 which gives full particulars.

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LINK-BELT

Bay City Clamshell Excavator

Producers who are using Bay City excavators with the shovel type dipper will be interested in the clamshell adaptation of Bay City equipment as shown in this illustration of an excavator used by the Amsterdam Coal Company at their gravel pit near Amsterdam, N. Y. A Bay City Excavator with clamshell adaptation is of considerable use where a shovel can-

not be used on account of the height of screen in the bed of the pit. The Amsterdam machine here shown is located at the top of the pit and loads gravel direct into a hopper which feeds the gravel screen. For full particulars write the Bay City Dredge Works, Bay City, Mich.

New Catalog of Acme Motor Trucks

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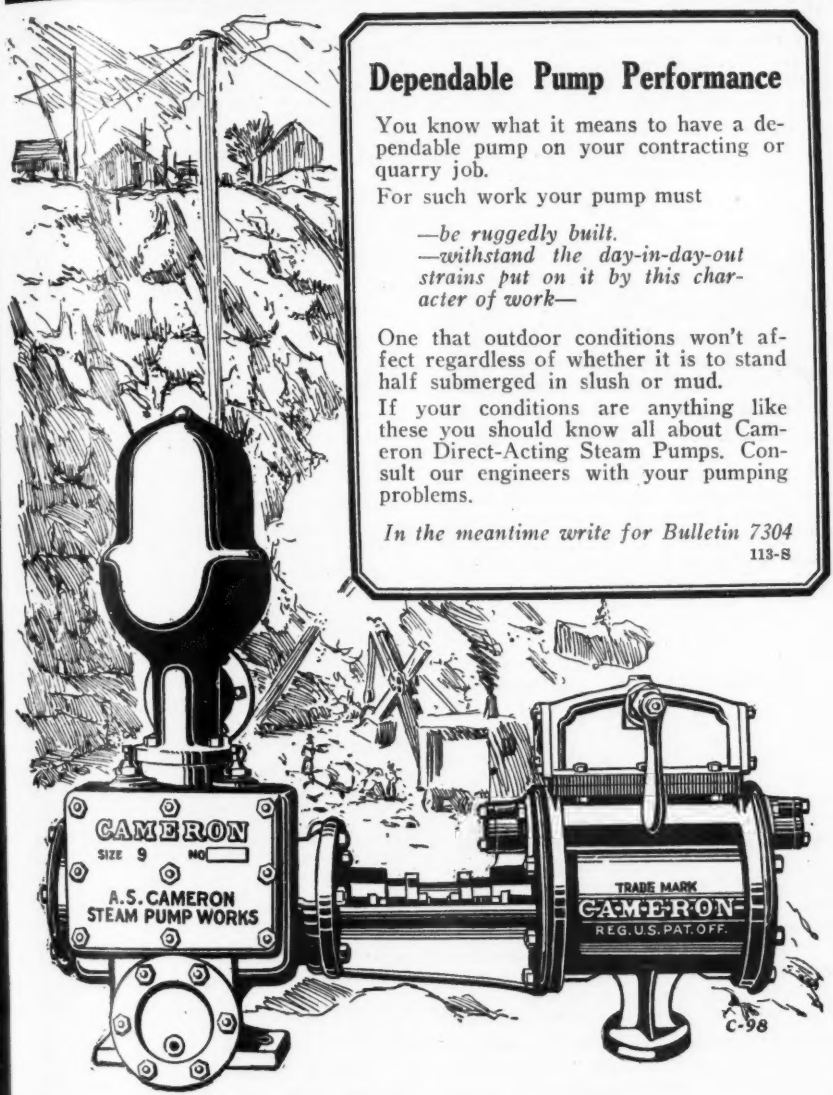

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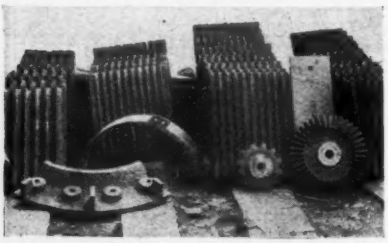

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Member Audit Bureau of Circulations
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VOL. 6 CHICAGO, ILL., SEPTEMBER, 1922 NO. 12

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Bay City Clamshell Excavator

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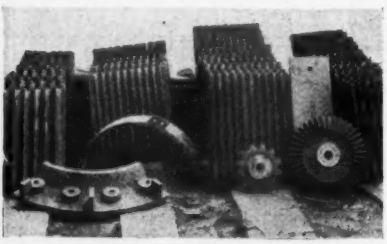

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